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REVISION PAGE

LTR	DATE	CHANGE	PAGES ADDED	PAGES DELETED	PAGES CHANGED	APPROVED BY

LIST OF FIGURES

LIST OF ABBREVIATIONS

AATF	-	Airworthiness Assurance Task Force
AAWG	-	Airworthiness Assurance Working Group
AC	-	Advisory Circular
AD	-	Airworthiness Directive
ARAC	-	Aviation Rulemaking Advisory Committee
BZI	-	Baseline Zonal Inspection
DSG	-	Design Service Goal
FAA	-	Federal Aviation Administration
FAR	-	Federal Airworthiness Regulation
JAA	-	Joint Airworthiness Authorities
JAR	-	Joint Airworthiness Regulation
NPRM	-	Notice of Proposed Rulemaking
OEM	-	Original Equipment Manufacturer
SB	-	Service Bulletin
SRM	-	Structural Repair Manual
SSIP	-	Structural Supplemental Inspection Program
STG	-	Structures Task Group
TAEIG	-	Transport Aircraft and Engine Issue Group

EXECUTIVE SUMMARY

Continued airworthiness assessment of existing repairs was identified as a significant concern by the Airworthiness Assurance Task Force (now known as the Airworthiness Assurance Working Group (AAWG)) in June 1988. The industry, with the cooperation of the regulatory agencies, has been in continuous review of the issues surrounding continued airworthiness of structural repairs since that time. This report documents the findings of the AAWG on this issue.

This report advocates that a one time structural repair assessment task for the external fuselage pressure boundary [fuselage skins and bulkhead webs] for continued airworthiness be added to the normal maintenance program for the Airbus A - 300; BAC 1 - 11; Boeing 707/720, 727, 737, 747; Douglas DC - 8, DC - 9/MD - 80, DC - 10; Fokker F-28; and the Lockheed L - 1011. The purpose of the assessment is to establish appropriate maintenance programs for certain repairs to ensure their continued airworthiness. The repair assessment guidelines detailed by this report is supported by OEM supplied model specific repair assessment documents, structural repair manual updates, and detailed training programs.

The report also advocates that while existing FAA regulations are sufficient to ensure compliance with the proposed repair assessment guidelines, this program be mandated by rule changes to 14 CFR Parts 43, 91, 121, 125, and 129. The proposed rule also specifies model specific implementation times for when individual aircraft are to be included in the assessment process. In addition, the rule changes are supported by a proposed Advisory Circular that provides information on program implementation.

These recommendations are supported by an extensive assessment of 1051 structural repairs installed on 65 airplanes of the types listed above.

In examining the issue of the continued airworthiness of structural repairs, the AAWG reached six conclusions and six recommendations.

CONCLUSIONS

As a result of the studies carried out on existing in-service repairs by the AAWG, the following conclusions were reached:

- The industry as a whole lacks sufficient information and training to evaluate previous installed repairs for continued airworthiness.
- Some existing repairs may require supplemental inspections to maintain structural airworthiness.

- Sufficient operational rules exist to enforce inspection programs on repairs for structural integrity but may not be sufficient to highlight the concern and necessary action to be taken.
- Data from surveys of repairs indicates no immediate airworthiness concern for previously installed repairs.
- Fuselage pressure boundary repairs represent the most significant concern to safety.
- Airline maintenance programs are focused to identify questionable repairs and replace them.

RECOMMENDATIONS

Based on the conclusions of this report and with respect to the external fuselage pressure boundary [fuselage skins and bulkhead webs] it is recommended:

- That the Federal Aviation Administration (FAA) consider a rule change to 14 CFR 91, 121, 125, and 129 be promulgated to ensure that an assessment for continued airworthiness for structural repairs on the fuselage pressure boundary of the Airbus A - 300; BAC 1 - 11; Boeing 707/720, 727, 737, 747; Douglas DC - 8, DC - 9/MD - 80, DC - 10; Fokker F-28; and the Lockheed L - 1011 be accomplished. The suggested wording of these new rules is contained in Section 7 of this report.
- That the FAA consider an Advisory Circular to provide guidance on rule accomplishment. The suggested wording of this Advisory Circular is contained in Section 8 of this report.
- That the Original Equipment Manufacturer (OEM) provide sufficient published data in the SRM, supported by model specific repair assessment guidelines material, to enable the operator to assess existing and proposed repairs.
- That the FAA require Supplemental Type Certificate Applicants to evaluate the effect of repairs in the vicinity of the planned structural modification for potential impact to continued airworthiness.
- That the Transport Aircraft and Engine Issue Group (TAEIG) recommend that the issues discussed in this report become the subject of an international harmonization task.
- That the OEMs provide repair assessment briefings and training to operator maintenance and engineering personnel and regulatory agencies within one year of initial publication of model specific repair assessment procedures.

1.0 Background

This proposal, to require the incorporation of repair assessment guidelines into the maintenance programs for certain transport category airplanes, follows from commitments made by the FAA and the aviation community in June of 1988 to address the issues concerning the safety of aging transport airplanes.

A high-cycle transport airplane enroute from Hilo to Honolulu, Hawaii suffered major structural damage to it's pressurized fuselage during flight in April 1988. In June of 1988 the FAA sponsored a conference on aging airplanes. The apparent economic feasibility of operating certain older technology airplanes had resulted in the operation of airplanes beyond previously projected retirement age. Because of the problems revealed by the accident in Hawaii and the continued usage of older airplanes, it was generally agreed that increased attention needed to be focused on the aging fleet and on maintaining its continued operational safety.

The Air Transport Association of America (ATA) and the Aerospace Industries Association of America (AIA) committed themselves to identifying and implementing procedures to ensure the continuing structural airworthiness of aging transport category airplanes. An aging aircraft task force with representatives from the aircraft operators, OEMs, regulatory authorities, and other aviation representatives was established in August 1988. The task force, then known as the Airworthiness Assurance Task Force (AATF), set forth five major elements of a program for keeping the aging fleet safe: (1) select service bulletins, applicable to each airplane model in the aging transport fleet, and recommend mandatory incorporation of terminating modification, (2) develop corrosion-directed inspection and prevention programs, (3) develop generic structural maintenance program guidelines for aging airplanes, (4) review and update the Supplemental Structural Inspection Documents (SSID), and (5) assess repair damage tolerance. Structures Task Groups (STG) sponsored by the AATF were assigned the task of developing these elements into usable programs, Figure 1.1.

Today the AATF, now known as the Airworthiness Assurance Working Group (AAWG), has largely completed its work on the first four elements. The rulemaking contained herein would bring the fifth element, the assessment of repair damage tolerance, to fruition.

Figure 1.2 details the industry activities since 1988 on the subject of continued airworthiness of structural repairs. Major activities to develop the recommendations in this report included meetings at all levels of the industry including the Structures Task Group (STG), and the AAWG. Industry concerns for direction and priorities for assessment of existing repairs were expressed by the AAWG in April 1991. As a result, the AAWG drafted and published criteria for a consistent examination of the repair issue in December 1991. At that time the AAWG formed a Repair Assessment Task Group (RATG) made up of operators, OEMs and regulators to focus the development of recommendations. Amongst other guidance from the AAWG was direction for an in depth review of in-service repairs as well as consistency of approach from the various OEMs.

In 1991, the AAWG was placed under the auspices of the Aviation Rulemaking Advisory Committee (ARAC) as part of the Transport Aircraft and Engine Issues Group (TAEIG). The issue of repair assessment was subsequently officially tasked to the AAWG by the FAA (see Appendix C of Attachment 2).

In April 1993, the Task Group formed by the AAWG presented their recommendations for review and approval (Attachment 2). The recommendations were accepted, with a minority position from the FAA, and forwarded to the TAEIG for acceptance and forwarding to the FAA. Due consideration of those recommendations revealed that consensus could not be reached and the report was returned to the AAWG for reconsideration.

The main consideration that prevented acceptance of the report by TAEIG was the AAWG position that no new regulations were required to insure compliance with the program. In September of 1993 the AAWG carefully reviewed the concerns of the TAEIG and then accepted the task of developing rule and guidance language subject to the following requirements:

- That the OEMs update SRMs to include damage tolerance rated structural repairs (ATA Chapters 51 through 57 plus others as appropriate).
- That the OEMs produce model specific program documents that will contain FAA approved data on means to evaluate existing repairs within an operator's fleet.
- That the OEMs provide training on the use of the model specific program data to both the operators and regulators.
- That operators would perform a one time evaluation of existing repairs by a predetermined model specific implementation time to establish the required supplemental maintenance programs (as necessary) for those repairs.
- That the initial effort be directed towards fuselage (Chapter 53) repairs with other repairs considered later.
- That the OEMs agree to have the necessary data for the program available and training started one year before the effective date of the notice of proposed rulemaking (NPRM).
- That the program not require special reporting requirements.
- That the program would be enforced through an FAR rule.

This position was accepted by the AAWG by an eleven to one vote. The minority position was expressed by an operator who stated that nothing has changed to reverse the earlier position; namely, that repairs on aircraft in question, have never been shown to be a safety concern and that rulemaking is premature until the voluntary commitment on the part of the operators and OEMs, has been shown to be ineffective (see Attachment 2, Conclusions and Recommendations). Based on the FAA position that rulemaking was absolutely required for this issue, the operator in question agreed that it would be best to assist in the development of the necessary language even though the operator believes it to be premature.

The following sections describe the AAWG tasking to develop recommendations for evaluation of existing repairs, the approach taken for repair evaluations, recommendations for development of Structural Repair Manual (SRM) updates and model specific repair assessment documents approved by the FAA. Sections 7 and 8 present the proposed rule language and advisory material for codification.

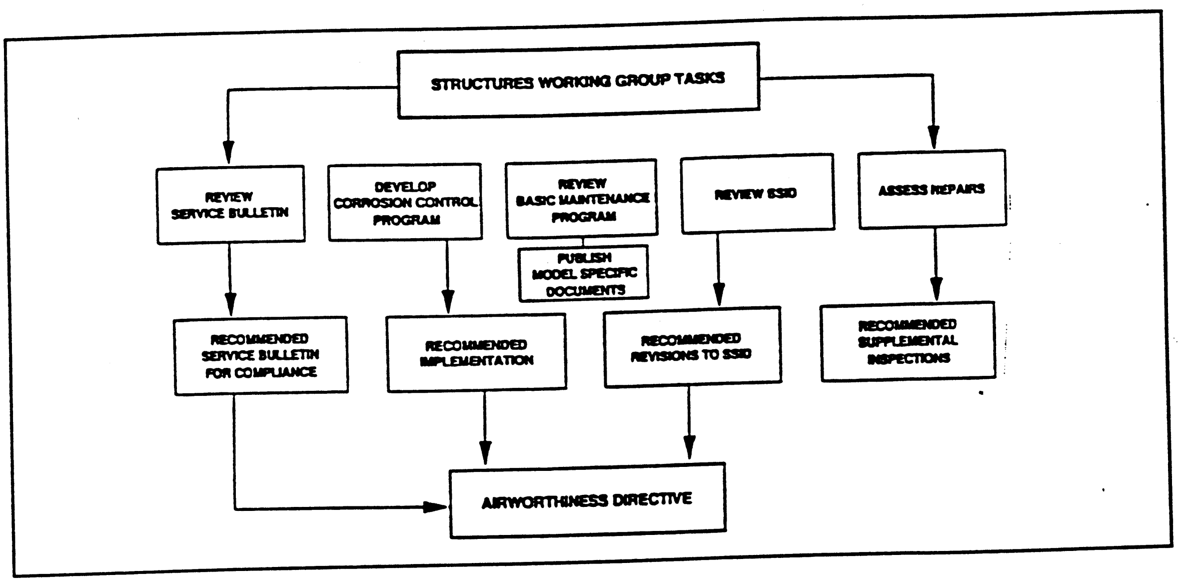

Figure 1.1 Industry Aging Fleet Program

DATE	ACTIVITY
JUN 1988	Repair Assessment Chartered By Airworthiness Assurance Task Force
FEB 1990- SEP 1991	Program Development (SWG, OEM, and AAWG Subcommittee Meetings) (11 Meetings held in this period)
DEC 1991	Industry Concerned With Program Direction
DEC 1991	Repair Assessment Task Group Chartered by AAWG
MAR 1992	Repair Survey of 30 Airplanes (Surveys conducted in California and Texas)
APR 1992	RATG Recommendations Developed; Seattle, WA.
APR 1992	RATG Recommendations presented to AAWG; Washington D. C.
MAY 1992	RATG Met to Discuss Repair Assessment Guidance Material and Means of Publication; Seattle WA.
MAY 1992	RATG Subcommittee on Repair Assessment Status; Long Beach CA.
JUN 1992	SRM and Guidance Material Reviewed During AAWG Meeting; Amsterdam
JUN 1992	Operator Caucus on Repair Assessment; Atlanta, GA.
SEP 1992	OEM Caucus on Repair Assessment; Seattle, WA.
OCT 1992	AAWG Progress Review of RATG Task; Washington D. C.
NOV 1992- FEB 1993	Key Repair Assessment Issues Resolved During Two RATG Meetings; Washington D. C.
MAR 1993	Repair Assessment Report Drafted and Approved
APR 1993	RATG Recommendations Presented to AAWG; Washington D. C.
APR 1993	AAWG/RATG Recommendations Presented to ARAC; Albuquerque, NM
AUG 1993	Minority Positions on Repair Assessment Presented to ARAC; Seattle WA
SEP 1993	AAWG Reaches Consensus For Repair Assessment Rule; Orlando FL
FEB 1994	Repair Assessment Rule Discussed at AAWG Meeting; Memphis TN
APR 1994	Repair Survey of In-service Airplanes by Operators/OEMs
JUN 1994	Repair Rule Writing Task Group (RRWTG) Formed by AAWG; Washington DC
AUG 1994	RRWTG Meeting with FAA Economists; Washington D. C.
SEP 1994	RRTWG Meeting to Review Rule/AC Content; Washington D. C.
NOV 1994	RRWTG Issue Draft Final Report Containing Rule and AC
MAR 1995	FAA Legal/PMI Review of Proposed Rule and AC; Albuquerque NM
JUN 1995	AEA/AECMA/AIA/JAA Meeting; Hoofddorp NL
OCT 1996	FAA Finishes Preliminary Legal / Economic Review of Rule and AC
DEC 1996	AAWG Issues Final Report to TAEIG (ARAC)

Figure 1.2 Industry Activities for Repair Assessment

2.0 AAWG Tasking

The AAWG activities since 1991 have been formally incorporated in the Aviation Rulemaking Advisory Committee (ARAC) structure. The specific task defined by ARAC for the AAWG was to develop recommendations concerning whether new or revised requirements and compliance methods for structural repair assessments of existing repairs should be initiated and made mandatory for Airbus A - 300; BAC 1 - 11; Boeing 707/720, 727, 737, 747; Douglas DC - 8, DC - 9/MD - 80, DC - 10; Fokker F-28; and Lockheed L - 1011.

3.0 Existing Regulation Analysis

Since the AAWG was tasked to investigate the preparation of additional rules to cover repairs to the eleven models of airplanes under the ARAC Tasking, it is important to understand how current regulations affect operators maintenance actions for repairs and how those regulations have evolved over the years.

3.1 Current Regulatory Status

Rules and guidelines that address repairs today are broadly based on certification and operational requirements. These include the following:

- FAR 1.1 - Major Alteration, Major Repair (Amendment 27)
- FAR 25.571 - Damage Tolerance Analysis (Amendment 45)
- FAR 25.1529 Appendix H25.4 - Airworthiness Limitations Section (Amendment 54)
- FAR 43.13 - Performance Rules (General)
- FAR 43.16 - Airworthiness Limitations (Amendment 54)
- FAR 43 Appendix A - Major Alterations, Major Repairs, and Preventative Maintenance (Amendment 52)
- FAR 91.403 - General (Amendment 54)
- AC 25-1529-1 - Instructions for Continued Airworthiness of Structural Repairs on Transport Airplanes (August 1, 1991)
- AC 91-56 - Supplemental Structural Inspection Program for Large Transport Category Airplanes

A review of these documents indicates that airplanes certified before FAR Amendment 45 regulations require structural repairs that restore static strength capability in accordance with FAR 1.1 and FAR 43. There is also guidance material which requests an evaluation to see if special inspection programs are necessary to detect premature degradation of structural damage tolerance capabilities as a result of repair installations. Furthermore, there are regulations that provide for mandatory compliance of any special inspection programs developed as part of the requested repair installation evaluation.

The advent of the Supplemental Structural Inspection Programs (SSIP) in the 1980's required supplemental inspections of certain structure called Principal Structural Elements (PSEs). In 1991 the FAA published AC 25.1529-1 that addresses the approval procedures to follow when making structural repairs to candidate airplanes subject to SSIP requirements. However, the methods provided herein are not the only means acceptable for ensuring continued airworthiness of structural repairs. The concepts of the SSIP are similar in nature to the new airplane Airworthiness Limitations Instructions (ALI) under FAR 25.1529.

Today's operational rules are similar for both the pre- and post- Amendment 45 airplanes in regards to performance standards that an airline must adhere to in repairing or altering an airplane. The requirements are clearly spelled out in FAR Part 43, Section 13(b), which states:

> "Each person maintaining or altering, or performing preventive maintenance, shall do that work in such a manner and use materials of such quality, that the condition of the aircraft, airframe, aircraft engine, propeller, or appliance worked on will be at least equal to its original or properly altered condition (with regards to aerodynamic function, structural strength, resistance to vibration and other deterioration, and other qualities affecting airworthiness)."

FAR 43.16 addresses airworthiness limitations, which states,

> "Each person performing an inspection or other maintenance specified in an Airworthiness Limitations section of a OEMs maintenance manual or Instructions for Continued Airworthiness shall perform the inspection or other maintenance in accordance with that section, or in accordance with operations specifications approved by the Administrator under Parts 121, 123, 127, or 135, or an inspection program approved under 91.409(e)."

[Docket No. 8444 (33 FR 14104, 9/18/68)]

> FAA comments regarding FAR 43.16 is documented in Amendment 43-20, Proposal 8-3, pages P - 56 and P - 57, Proposal 8 - 21, page P - 62 and Proposal 8 - 107, pages P - 78 and P - 79 support and address "Instructions for Continued Airworthiness." Upon FAA approval and OEM release of the model specific SRM updates and guidance materials, these repair assessment documents can be considered as a section of the OEMs maintenance manual or the Instructions for Continued Airworthiness.

It is interpreted that these requirements direct an airline to repair airplanes in accordance with the rules under which a particular piece of structure was certified. If the structure was certified as damage tolerant or under the requirements of an SSIP, the structure would need to be repaired in a fashion that would be equivalent to the basic PSE and/or provide an inspection program to maintain airworthiness for candidate airplanes subject to SSIP requirements.

In addition to the documents above, the FAA has created various policy documents regarding continued airworthiness and repairs. Three of these documents are listed below.

- Repairs Made to Primary Structures on Transport Airplanes, ANM-100, April 29, 1986
- Repairs Made to Primary Structures on Transport Airplanes, NTSB A-85-140, ANM-100, June 3, 1986
- Policy Regarding Impact of Modifications and Repairs on the Damage Tolerance Characteristics of Transport Category Airplanes, ANM-100, October 27, 1989

These documents do not affect the day to day operation of airplanes requiring repairs, but are included here for completeness.

Currently there are no requirements that address retroactive requirements regarding the continued airworthiness of repairs previously installed on pre-Amendment 45 and 54 airplanes.

3.2 Responsibility

The responsibility for repairs installed on airplanes resides with the OEM for those airplanes in the process of being manufactured (FAR 21.125) and with the operator for those airplanes in-service (FAR 43.13(b), 43.16, 121.363, 367, and 369(2), (5) and (6)). It is also envisioned that international harmonization is necessary for repair assessment responsibilities.

The OEM has historically provided FAA approved repairs as a service to its operators. These repairs may be in a Structural Repair Manual or may be directly requested by the operator. Repair data may also be developed by the operators, independent DERs, or the regulatory agencies themselves. Repairs adjacent to or on third party structural modifications (STCs) may require special analysis that is only available at the STC holder.

3.3 Synopsis

It would appear that sufficient rules exist for the proper execution of repairs that will maintain continued airworthiness of the fleet. However, some OEMs and the regulators feel that the adoption of the program by all operators can not be expected without additional rulemaking.

4.0 Approach

Prior to April 1991, the repair assessment task was approached on a model by model basis. Concerns for program direction and priorities for assessment of existing repair subsequently resulted in the AAWG drafting criteria for repair assessments:

4.1 AAWG Repair Criteria (December 1991)

The following criteria will be considered when developing guidance material for repairs requiring specific maintenance programs to maintain the damage tolerance integrity of the basic airframe.

- Specific repair size limits should be selected for each model of airplane.
- Repairs which have been superseded require review.
- Repairs in close proximity may jeopardize the continued airworthiness of the airplane.
- Repairs that do not conform to SRM standards may require further action.
- Repairs which exhibit structural distress should be replaced before further flight.

4.2 AAWG Five-Step Approach to Repair Assessment (December 1991)

It became clear that more fleet evidence was required to scope the overall problem in terms of any continued airworthiness concerns. This resulted in formulation of a five-step AAWG approach to repair assessments in December 1991 (see Appendix D, Attachment 2):

- Develop model specific guidance using AAWG repair criteria.
- Survey a number of operators' airplanes to:
  - Assesses fuselage skin repairs below window belt.
  - Validate approach.
  - Form basis for broader effort.
- Develop world wide survey if required.
- Collect and assess results to determine further course of action by mid 1992.
- Develop specific OEM/operator/FAA actions.

5.0 Repair Surveys

Concern over the repairs program dictated that accurate data be collected to identify the scope of the program. The AAWG conducted two separate surveys of repairs placed on airplanes to collect the necessary data. The first survey occurred in 1992, and the second survey in 1994.

5.1 1992 Fuselage Repair Survey of Stored Airplanes

The surveys were performed on airplanes stored at Mojave, California and Amarillo, Texas and coordinated with airplane owners by the FAA. There were a total of five teams involved in the surveys. Each team was comprised of five engineering representatives from various organizations including FAA Aircraft Certification and Flight Standards Offices, operators and OEMs. Details of this survey can be found in Appendix E of Attachment 2. The prime directive for this survey was to conduct sample surveys of fuselage repairs located below the window belt, Figure 5.1.

The survey teams used the following procedures:

- Survey and document lower surface fuselage repairs on selected Airbus, Boeing, Douglas, and Lockheed airplanes.
- Categorize repairs into three groups using engineering judgment and applicable AAWG screening criteria (Appendix D, Attachment 2):
  - No additional action required (Category A).
  - Repair may require supplemental inspection for damage tolerance or additional rework (Category B and C).
  - Repair does not meet the minimum requirements of a Category C repair (remove and replace repair with Category A, B or C repair prior to return to service).
- Summarize data finding.

A total of 356 repairs were evaluated on 30 airplanes over a three day period.

SCOPE OF REPAIR SURVEYS

- **External visual observation of external lower fuselage plating repairs.**
- **Inspections designed to be conducted quickly, with no more than a work stand and light.**
- **Repairs which clearly do not meet existing Structural Repair Manual guidance will be reported to the operator.**

PURPOSE OF REPAIR SURVEYS

- **Gain first-hand observations of typical repairs.**
- **Sample of numbers, types, proximity, condition of repairs, etc.**
- **Identify SRM quality repairs that may require additional attention to ensure continued airworthiness.**
- **Observe any repairs which are below SRM standards.**
- **Develop a qualitative opinion of the team's concern for repairs as a safety issue, if any.**

DISPOSITION OF SURVEY FINDINGS

- **Document the observations in a standard way that can be combined for all OEMs.**
- **Make recommendations for further effort as appropriate.**

Figure 5.1 Objectives of 1992 Repair Surveys

5.2 1994 Repair Survey of In-service Airplanes

During the 2nd quarter of 1994, the AAWG requested that the OEMs conduct a second survey on airplane repairs to validate the 1992 results and to provide additional information relative to the estimated cost of the assessment program. The OEMs were requested to visit airlines operating their products and to conduct surveys on airplanes in heavy maintenance. An additional 35 airplanes were surveyed in which 695 repairs were evaluated. This survey was expanded to include all areas of the airframe. The evaluation revealed substantially similar results to the 1992 survey in which 40% of the repairs were classified as adequate and 60% of the repairs required consideration for additional supplemental inspection during service. In addition, only a small number of repairs (less than 10%) were found on other portions of the airframe.

5.3 Survey Conclusions

Figures 5.2 and 5.3 summarize the survey findings. These surveys provided first hand observations of service repairs in terms of type, proximity, condition and number of repairs relative to standardized common criteria. The survey findings were reviewed by the RATG. Figures 5.4 and 5.5 show conclusions and recommendations from the repair surveys. These surveys demonstrated that some repairs of good quality may inhibit damage detection during normal maintenance activities and therefore may need supplemental inspection due to size, configuration and/or proximity considerations.

The repair surveys did not indicate an immediate concern for continued structural airworthiness. The size distribution of repairs, Figure 5.6, indicated a need for assessments to establish inspection requirements for larger repairs and/or smaller repairs in close proximity. It was concluded that operators need updated SRMs and model specific guidance documents to accomplish their repair assessments.

Additionally, the results of the survey did not indicate a sizable number of repairs on structure other than the fuselage. Based partly on this finding, the initial task is limited to the external fuselage pressure boundary [fuselage skins and bulkhead webs] Future rule making activity would address the remaining primary structure. This limitation is based on two considerations.

First, the fuselage is more sensitive to structural fatigue than other airplane structure because its normal operating loads are closer to its limit design loads. Stresses in a fuselage are primarily governed by pressure relief valve settings of the environmental control system, and these are less variable from flight to flight than the gust or maneuver loads that typically determine the design stresses in other structure. Second, the fuselage is more prone to damage from ground service equipment than other structure and requires repair more often. The results of the second survey described above supports the conclusion that repairs to the fuselage are far more frequent than to any other structure.

AIRPLANE MODEL	AIRPLANES SURVEYED ('92/'94/TOTAL)	REPAIR CLASSIFICATION		
		REPAIRS RE-QUIRING NO ADDITIONAL ACTION (CATEGORY A) ('92/'94/TOTAL)	REPAIRS REQUIR-ING SUPPLEMEN-TAL INSPECTIONS (CATEGORY B OR C) ('92/'94/TOTAL)	TOTAL RE-PAIRS SUR-VEYED ('92/'94/TOTAL)
727	6 / 7 / 13	39 / 100 / 139	66 / 109 / 175	105 / 209 / 314
737	5 / 4 / 9	41 / 17 / 58	49 / 66 / 115	90 / 83 / 173
747	2 / 5 / 7	13 / 37 / 50	32 / 130 / 162	45 / 167 / 212
DC-8	0 / 3 / 0	0 / 56 / 56	0 / 43 / 43	0 / 99 / 99
DC-9	6 / 4 / 10	21 / 37 / 58	32 / 16 / 48	53 / 53 / 106
DC-10	0 / 4 / 4	0 / 12 / 12	0 / 21 / 21	0 / 33 / 33
A-300	9 / 0 / 9	17 / 0 / 17	18 / 0 / 18	35 / 0 /35
L-1011	2 / 0 / 2	12 / 0 / 12	16 / 0 / 16	28 / 0 / 28
F-28	0 / 8 / 8	0 / 10 / 10	0 / 41 / 41	0 / 51 / 51
TOTAL	30 / 35 /65	143 / 269 / 412	213 / 426 / 639	356 / 695 / 1051

Figure 5.2 AAWG Fuselage Surveys Statistics

- BASED ON AAWG REPAIR CRITERIA WITH OEM SIZE AND PROXIMITY LIMITS
- INSPECTED 65 AIRPLANES
  - 13:727, 9:737, 7:747, 3:DC-8, 10:DC-9, 4:DC-10, 9:A300, 2:L-1011 8:F-28's
- RESULTS
  - 1051 REPAIRS ASSESSED - 40% CLASS A, 60% CLASS B/C
  - AVERAGE OF 16 REPAIRS PER AIRPLANE
- GENERALLY THE REPAIRS WERE OF GOOD QUALITY AND APPEARED TO BE PER SRM
- THE SIZE/PROXIMITY CRITERIA DETERMINED ALMOST ALL CLASS B/C REPAIRS

Figure 5.3 Summary of Survey Results

- SURVEYS CONFIRM THE NEED FOR REPAIR ASSESSMENT EVALUATIONS
- NO IMMEDIATE REPAIR SAFETY CONCERN WAS OBSERVED
- OPERATORS NEED REPAIR ASSESSMENT PROCEDURES FROM OEMs FOR EXISTING AND NEW REPAIRS
- OLDER AIRPLANES GENERALLY HAVE MORE REPAIRS
- REPAIR ASSESSMENT TRAINING IS ESSENTIAL FOR:
  - OPERATORS
  - FAA PMIs OR FOREIGN EQUIVALENT
- THE VAST MAJORITY OF REPAIRS ARE ON THE FUSELAGE PRESSURE SHELL

Figure 5.4 Repair Survey Conclusions

- OEMs SHOULD UPDATE THE STRUCTURAL REPAIR MANUALS AND DEVELOP GUIDANCE MATERIAL FOR NEW AND EXISTING REPAIRS
- TYPICAL IMPLEMENTATION TIME FOR ANY SUPPLEMENTAL INSPECTIONS OF REPAIRS SHOULD BE AT DESIGN SERVICE GOAL OR NEXT ACCESS OPPORTUNITY WHICH EVER IS LATER
- THE RULE SHOULD BE LIMITED TO REPAIRS ON THE FUSELAGE PRESSURE BOUNDARY

Figure 5.5 AAWG Recommendations From Survey Results

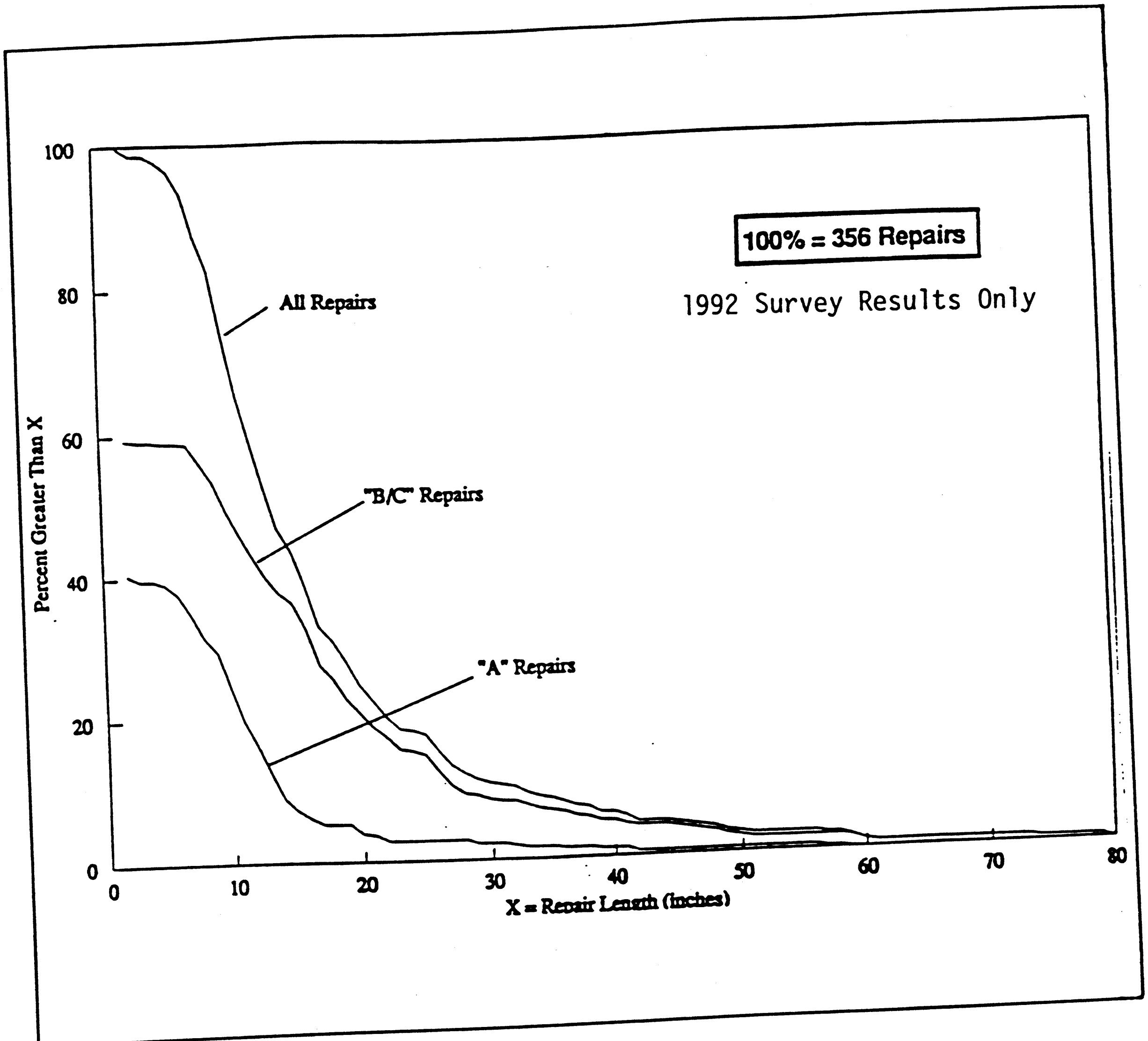

Figure 5.6 Fuselage Repair Size Distributions From 1992 Survey

5.4 *Repair Assessment Cost Estimate*

The AAWG also requested that the OEM examine the cost issues that might be incurred as a result of implementing the repair assessment guidelines. Data from both the 1992 and 1994 surveys were used to baseline assessment and inspection costs. The following ground rules were agreed to by the OEMs in developing the data:

- For the purposes of the estimate, the cost would be for one airplane of each type for a ten year period.
- The 1992 and 1994 data would be used to establish the number of repairs existent on a particular type at the assessment implementation time.

- The number of repairs determined in step two would be arbitrarily increased by 15% to account for repairs on the wing and empenange. This assumption is in fact very conservative based on the actual number of repairs found on the wing and empennage during the 1994 survey.
- The number of repairs requiring supplemental maintenance would be 60% of the total repairs on a given airplane at the implementation time.
- An individual repair would require the following time estimates for each maintenance operation:
  - One hour for repair classification.
  - Two hours for each repair inspection.
- Repairs requiring inspection were assumed to be inspected at the following times:
  - Each repair requiring inspection is inspected at the time of assessment.
  - One-half of the repairs are re-inspected at every 'C' check interval.
  - One-half of the repairs are re-inspected at every '4C' check intervals.
- The cost estimate does not include:
  - Any record search that an operator may need to do to determine when a particular repair was installed.
  - Any cost of administration incurred by an operator in executing this program:
    - ◊ Updating maintenance programs and obtaining FAA approval.
    - ◊ Any record keeping as defined in the operator's approach to program implementation.

Figure 5.7 shows the projected total number of repairs on an airplane by airplane type at the model specific assessment implementation time (see Figure 6.2). Figure 5.8 shows the estimate of the number of man-hours required per aircraft over the next ten years of operation. The total cost for assessment, excluding administrative costs, range from 80 man-hours to 350 man-hours per airplane.

MODEL	PROJECTED No. OF FUSELAGE SKIN REPAIRS (AT ASSESSMENT IMPLEMENTATION TIME)	No. OF "OTHER" REPAIRS (AT ASSESSMENT IMPLEMENTATION TIME) [1]	TOTAL REPAIRS (AT ASSESSMENT IMPLEMENTATION TIME)
727	29	5	34
737	34	6	40
747	37	7	44
DC-8	38	7	45
DC-9	18	3	21
DC-10	16	3	19
A300	33	4	37
L-1011	TBD [2]	TBD [2]	TBD [2]
F-28	10	2	12

[1] Very few external repairs were found on the wing and empennage. The analysis employs the AAWG estimates contained in the January 1994 meeting minutes (85% of the repairs are on the pressure shell and 15% are on other primary structure.

[2] Similar results are expected.

Figure 5.7 Estimate of Total Number of Repairs At Model Specific Assessment Implementation times

MODEL	PROJECTED No. OF REPAIRS PER A/C (AT ASSESSMENT IMPLEMENTATION TIME)	ESTIMATED No. OF REPAIRS WHICH MAY REQUIRE SUPPLEMENTAL INSPECTION (AT ASSESSMENT IMPLEMENTATION TIME)	ESTIMATED MAN-HOURS PER A/C OVER NEXT 10 YEARS [1]
727	34	19	210 HOURS
737	40	26	270 HOURS
747	44	34	350 HOURS
DC-8	45	19	220 HOURS
DC-9	21	9	110 HOURS
DC-10	19	12	120 HOURS
A300	37	31	215 HOURS
L-1011	TBD [2]	TBD [2]	TBD [2]
F-28	12	10	80 HOURS

[1] Cost figures based on 1.0 Hr. per repair assessment and 2.0 Hr. per repair inspection. Assumed 1/2 of the repairs inspected at "C" checks and the other 1/2 at four times the "C" check interval.

[2] Similar results are expected.

Figure 5.8 Cost of Repair Assessment and Supplemental Inspections

6.0 Repair Assessment Process

This section describes the elements of the repair assessment process:

- Baseline Zonal Inspection Program
- Structural Repair Manual Updates
- OEM Model Specific Repair Assessment Guidelines
- Program Implementation

6.1 Overview

The OEMs will provide SRM updates and model specific repair assessment guideline documents. With these documents, operators will be able to assess existing repairs to determine which permanent repairs require supplemental inspections beyond specific implementation times. Temporary repairs can also be assessed to determine the need for supplemental inspections before they reach their replacement implementation time. The documents can also be used to assess the maintenance requirements for repairs installed in the future. The OEMs have developed a Baseline Zonal Inspection (BZI) reflecting typical inspection intervals to facilitate the classification of repairs and need for supplemental inspections.

6.2 Program Objective

The objective of the repair assessment process is to assure continued structural repair airworthiness equivalent to unrepaired similar principal structural elements. The priority is to assess fuselage pressure boundary repairs for eleven pre-Amendment 45 airplanes (A-300, F-28, BAC 1-11, L-1011, DC-8, DC-9/MD-80, DC-10, 707/720, 727, 737, 747) with emphasis on the out-of-production models. Model specific repair assessment guidelines published by the OEMs could also be used to determine inspection requirements to meet the intent of AC 25.1529.1 for new repairs. The guidelines may be expanded to cover other structure beyond the fuselage pressure boundary, provided that it is fully justified through enhancement of continued structural airworthiness. The proposed repair assessment process could also be applied to post-Amendment 45 airplanes in satisfying AC 25.1529.1 guidance.

6.3 Baseline Zonal Inspections Program

The Baseline Zonal Inspection (BZI) reflects typical maintenance inspection intervals assumed to be performed by most operators. The BZI serves as an evaluation tool for some OEMs to establish criteria for supplemental inspections, repair size limits, etc. Some OEMs have developed the BZI in conjunction with Structures Task Group (STG) activities. The BZI provides opportunities to simplify the repair screening process (Section 6.5) with regards to structural locations based on stress environment and zonal critical details. The BZI will be listed in the OEM model specific guidance documents (Section 6.5). The operators have expressed their concurrence that the BZI is useful to simplify repair assessments. Appendix F of Attachment 2 shows a typical BZI program that would be used to evaluate the need for supplemental inspections of a repair.

6.4 Structural Repair Manual Content

Model specific Structural Repair Manuals (SRMs) will be updated by the OEMs to reflect damage tolerance repair considerations.

The general section of each SRM, Chapter 51, will contain brief descriptions of damage tolerance considerations and categories of repairs (Section 6.7). Chapter 53 for pressurized fuselage skin will be updated to identify repair categories and related information.

In updating each SRM, existing location specific repairs will be labeled with appropriate repair category identification (see Section 6.5 for repair categorization) and specific inspection requirements will also be provided as applicable.

Generic SRM repairs will also contain repair category considerations regarding size, zone and proximity to other repairs. Detailed information for determination of inspection requirements will be provided in separate guidance material for each model (Section 6.5). Repairs that are superseded in the future will be labeled inactive and remain in the SRM. Maintenance programs (e.g. inspection and , if necessary, replacement requirements) for superseded repairs will be added to the SRM. Updates of the SRM will be FAA (or equivalent) approved in line with current practice for revision approvals. An example of a typical SRM update is shown in Appendix G of Attachment 2.

The goal is to complete these updates within one year of AAWG, ARAC and STG adoption of the recommendations contained herein but not later than one year prior to the effective date of the rule. Consistent with the results of the industry surveys used to establish this program (Section 5.0), emphasis will be on external fuselage pressure boundary repairs.

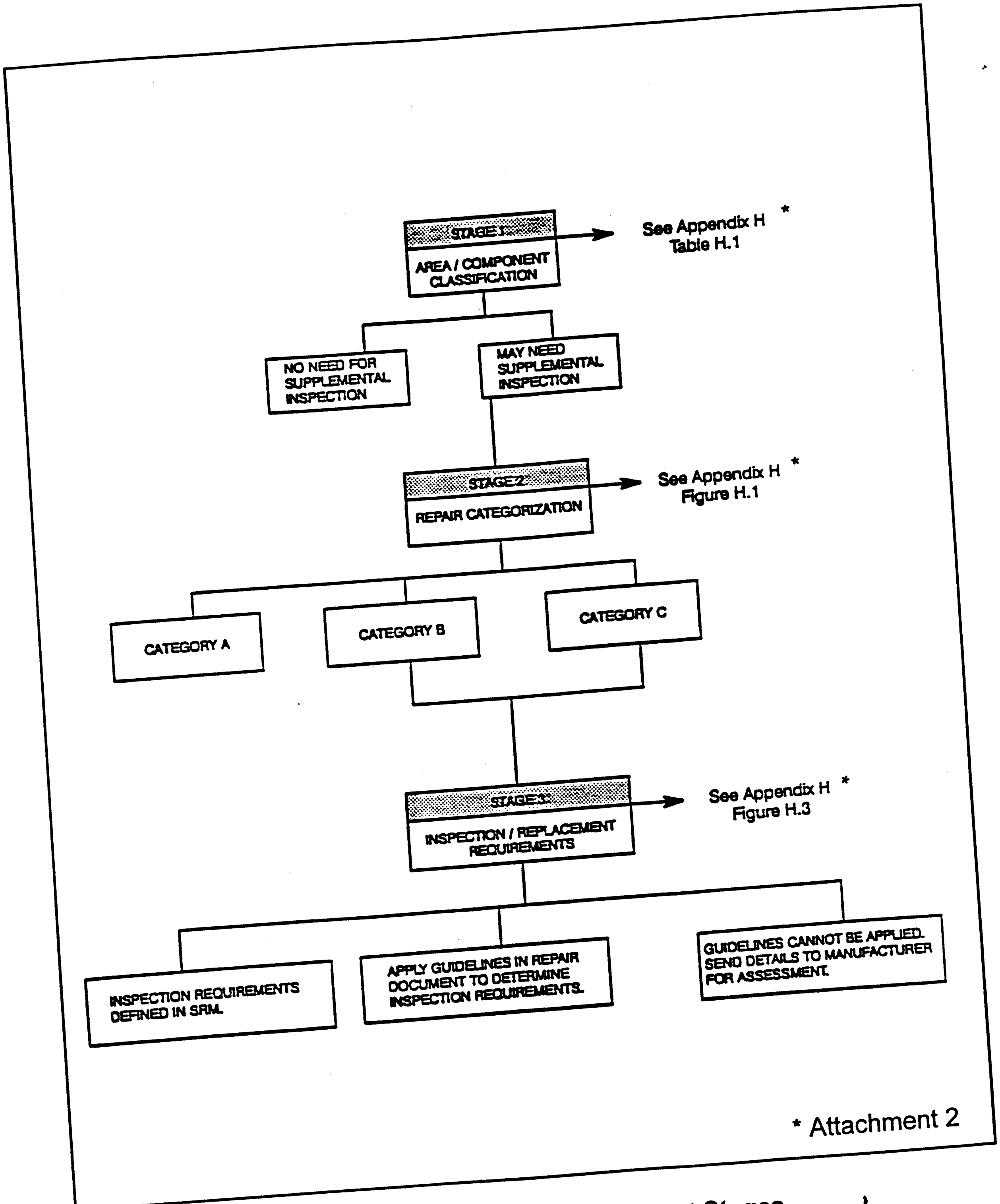

Figure 6.1 Repair Assessment Stages

6.5 Repair Assessment Guidance Material

Model specific documents will be prepared by the OEMs for the eleven aging airplane models. Uniformity/similarity of these repair assessment procedures are important to simplify operator workload. The OEMs have spent considerable time over the last five years to achieve commonality of the repair assessment process.

The model specific documents will describe rationale for repair Categories A, B and C:

- Category A

  A permanent repair for which the Baseline Zonal Inspection is adequate to ensure continued airworthiness (inspectability) equal to unrepaired surrounding structure.

  Category A fuselage skin repairs are encouraged unless operator convenience and scheduling dictates Category 'B' or 'C' selection.

- Category B

  A permanent repair which requires supplemental inspections to ensure continued airworthiness.

  The design goal for new Category B repairs should be equivalent to the basic structure design service goal in flight cycles.

- Category C

  A temporary repair which will need to be reworked or replaced prior to an established time limit. Supplemental inspections may be necessary to ensure continued airworthiness prior to this limit.

A number of different means may be used to incorporate the assessment guidelines into an operators maintenance program. One method is to incorporate the entire guidelines into the normal maintenance program similar to any other maintenance program. A program of this nature is suitable for any size of fleet but has distinct advantages for the larger operator who does not want to track individual repairs.

Another approach, more suitable for the small operator, is detailed below. This approach is known as the three stage approach (Figure 6.2) and is further detailed by an example contained in Appendix H of Attachment 2:

- STAGE 1 - DATA COLLECTION

  - This stage specifies what structure should be assessed for repairs. If a repair is on a structure in an area of concern, the analysis continues, otherwise the repair does not require classification per this program.
  - Guidance material documents for each model will provide a list of structure for which repair assessments are required. Some OEMs have reduced this list by determining the inspection requirements for critical details. If the requirements are equal to normal maintenance checks(e.g. BZI check), those details were excluded from this list.
  - Repair details are collected for further analysis in Stage 2. Repairs which do not meet the static strength requirements or are in a bad condition are immediately identified and corrective action must be taken before further flight.

- STAGE 2 - REPAIR CATEGORIZATION

  - The repair categorization is determined by using the data gathered in Stage 1 to answer simple questions regarding structural characteristics.
  - Well designed repairs in good condition meeting size and proximity requirements are Category A Simple condition and design criteria questions are provided in Stage 2 to define the boundaries of Category A, B and C repairs. The process continues for Category B and C repairs.

- STAGE 3 - DETERMINATION OF SUPPLEMENTAL MAINTENANCE REQUIREMENTS

  - The supplemental inspection and/or replacement requirements for Category B and C repairs are determined in this stage. Inspection requirements for the repair are determined by calculation or by using predetermined values provided by the OEM, STC holder or other values obtained using an FAA approved method.
  - The inspection intervals are based on residual strength, crack growth and inspectability evaluations. The inspection methods and intervals should be compatible with typical operator maintenance practice. Internal inspections are acceptable at 'D'-check or equivalent cycle limit intervals while simpler external inspections can be accommodated at multiple 'C'-check or equivalent cycle limit intervals.

A list of applicable Service Bulletins (SBs) and Airworthiness Directives (ADs) will be included and will be assessed by the OEM per Section 6.6. The required post modification/repair inspection programs will also be included.

The threshold for the first supplemental inspection will be defined in flight cycles and will be determined by the procedures found in the model specific documents. If the time of installation of the repair is unknown and the airplane has exceeded the assessment implementation time or has exceeded the time for first inspection, the first inspection should occur by the next 'C' - check interval or cycle limit equivalent after the start of the assessment process.

Incorporating the maintenance requirements for 'B' and 'C' repairs into the operators individual airplane maintenance program completes the repair assessment process.

The AAWG recommends that the assessments should be performed by well trained personnel, familiar with the damage tolerance assessment of repairs outlined in the model specific guidance material. The OEMs have agreed to provide training to both the operators and regulators to familiarize them on assessment criteria and implementation.

6.6 Fuselage External Pressure Boundary Service Bulletin Repairs

The OEMs should review repairs identified in Service Bulletins (SBs) to determine requirements for supplemental inspections if not already addressed. Structural modifications (either terminating repairs or preventative modifications) to terminate repeated inspections required by Airworthiness Directives (AD) do not always contain instructions for future supplemental inspection requirements. The AAWG recommends that these structural modifications be reviewed by the OEMs to evaluate the need for post modification inspections. This activity should be reviewed by the model specific OEM Structures Task Group. A list of Service Bulletins that are the subject of Airworthiness Directives will be contained in the model specific program document with required post modification inspection/repair programs as applicable.

A list of other structural SBs will be provided in the model specific guidance material with associated inspection thresholds and repeat intervals (separate repair assessment documents per Section 6.7). OEMs should complete their review of SB related skin repairs in conjunction with the initial SRM updates (Section 6.4).

6.7 Repair Assessment Implementation Time

Implementation time for assessments of existing repairs are based on the findings of the repair surveys and fatigue damage considerations. The repair survey findings indicated that all repairs reviewed appeared in good structural condition. It was therefore concluded that the assessment needed to be implemented sometime before a specific model reached it's Design Service Goal (DSG). Based on this logic, the OEMs and operators established an upper bound for an assessment to be completed and then reduced it to establish an implementation time. The upper bound for the incorporation of the repairs assessment program into an airplane's maintenance program was established as 75% of the DSG in the terms of flight cycles. The implementations times specified for each model are shown in Figure 6.2.

Existing fuselage repairs should be assessed using one of the procedures described in Section 6.5. The FAA Approved OEM model specific guidelines document specifies the specific cycle limits of when the assessment process must start. There are three implementation levels depending on the cycle age of the aircraft on the effective date of the proposed rule.

- <u>Airplane cycle age equal to or less than Implementation time on the rule effective date</u>. The operator would be required to incorporate the guidelines in his maintenance or inspection program by the flight cycle implementation time, or one year after the effective date of the rule, which ever occurs later. The assessment process would begin (e.g. accomplishment of Stage 1) on or before the cycle limit specified in the RAG (generally equivalent to a 'D' check) after incorporation of the guidelines.

- <u>Airplane cycle age greater than Implementation time but less than Design Service Goal on the rule effective date</u>. The operator would be required to incorporate the guidelines in his maintenance or inspection program within one year of the rule effective date. The assessment process would begin (e.g. accomplishment of Stage 1) on or before the cycle limit in the RAG (generally equivalent to a 'D' check), not to exceed the cycle limit computed by adding the DSG to the cycle limit equivalent of a 'C'-check (also specified in the RAG) after incorporation of the guidelines.

- <u>Airplane cycle age greater than Design Service Goal on rule effective date</u>. The operator should incorporate the guidelines in his maintenance or inspection program within one year of the rule effective date. The assessment process would begin (e.g. accomplishment of

Stage 1) on or before the next 'C'-check or cycle limit specified in the RAG (equivalent to a 'C' check) after incorporation of the guidelines.

Model	Implementation time (Flights)
A-300	36,000 - B2
A-300	30,000 - B4-100 above window belt
A-300	36,000 - B4-100 below window belt
A-300	25,500 - B4-200 above window belt
A-300	34,000 - B4-200 below window belt
BAC 1-11	60,000
B 707	15,000
B 720	23,000
B 727	45,000
B 737	60,000
B 747	15,000
DC-8	30,000
DC-9/MD-80	60,000
DC-10	30,000
L-1011	27,000
F-28	60,000 - mark 1000, 1000C, 2000, 3000, 3000C and 4000

- Note: the A-300-B4-600, F-28 mark 70, and the F-28 mark 100 are certified to post amendment 54 and are not considered part of this rule process.

Figure 6.2 OEM Recommended Repair Assessment Implementation Times

6.8 Incorporation of Assessment Guidelines into a Maintenance Program

The implementation of the program is at the operator/individual airplane level. In order to comply with the requirements of the rule, an operator must update and have approved his means of approach on an individual airplane maintenance level prior to an airplane reaching it's model specific repair implementation time (Paragraph 6.7) unless the airplane has exceeded or is within one year of exceeding the stated implementation time in which case the operator has one year from the effective date of the rule to do so.

The FAA Approved model specific OEM guidance documents specify when the repair assessments need to be accomplished and are in terms of flight cycles or a cycle limit.

The means by which the FAA Approved repair assessment guidelines is incorporated into a certificate holders FAA Approved Maintenance Program as required by the rule is the subject of negotiation between the certificate holder and his PMI with the exception of the following issues which must be submitted to the cognizant FAA ACO for approval:

- Implementation times,
- Threshold and repeat inspection methodology different from the FAA approved documents or any other FAA approved method,
- Changes to the baseline zonal inspection program,
- New methods of inspection.

6.9 Publication of OEM Documentation

For airplane models in which the high time airplane has not reached the respective model specific repair assessment implementation times, the SRM updates and model specific guidance documents should be available a minimum of one year prior to the high time airplane reaching the implementation time (Figure 6.2). In the event that the high time airplane is within one year of the implementation time or has already exceeded the implementation time, the documentation will be available one year prior to the effective date of the rule.

Model specific documents will be reviewed for consistency by the cognizant STG prior to OEM submittal to the FAA for approval. STG recommendations for changes to the document will be considered by the OEM.

6.10 Training

The complexity of the repair assessment requires adequate training for proper implementation. Therefore the AAWG recommends that each OEM provide detailed in-depth training for all operators of the airplanes considered by this rule. In addition, the AAWG further recommends that the OEM provides similar in-depth training to the Regulator's Principal Inspectors who are charged with the responsibility of operator oversight of the program.

6.11 Program Implementation Examples

The following describe three variants of acceptable means to comply with FAR 91.XXX, 121.XXX, 125.XXX AND 129.XXX. These examples are not exhaustive and are intended to show a variety of different acceptable approaches. Any approach adoped as a means of compliance to the proposed rules would need to be approved by the regulatory authority.

Example 1. At a prescribed "D" check or equivalent cycle limit, the effected airplane will require the following activities:

(a) Using the guidelines agreed upon by the model specific Structures Task Groups (STG) and the OEM, the operator will evaluate each repair on the fuselage pressure boundary [fuselage fuselage skins and bulkhead webs] to determine it's repair categorization and applicable continued airworthiness inspection or replacement program.
(b) Category 'C' repairs may be evaluated to determine if it should be improved immediately or reinspected for upgrade at a later time.
(c) If it can be shown that category 'B' or 'C' repair inspection requirements are already fulfilled by a maintenance planning item, there is no need to add a specific maintenance task item in the approved maintenance program applicable to the airplane. If not, the approved maintenance program for the airplane will need to be updated accordingly to include the specific additional maintenance requirements applicable to the repair.

Example 2. Operators with large fleets who do not wish to track each individual repair but instead wish to demonstrate compliance during routine heavy maintenance visits may utilize the following procedure as a means of compliance to FAR 91.XXX, 121.XXX, 125.XXX AND 129.XXX.

(a) An "alarm clock" would be installed in the individual airplane maintenance program to monitor individual airplane landing cycles. This alarm clock would be activated upon an airplane reaching it's implementation age and issue a routine job instruction package for the maintenance visit. This routine job instruction package would consist of:

(1) A diagram segmenting the airplane pressure shell into small zones.
(2) A requirement to inspect each zone to identify repairs for possible inspections.
(3) A requirement to evaluate each repair per OEM repair program guidelines and the SRM to ensure repairs satisfy 'B' or 'A' repair category. An operator could maintain a repair log of each airplane to aid in the identification of existing repairs at subsequent airplane visits.
(4) An individual repair that does not satisfy the requirements for continued airworthiness until the next heavy maintenance visit, will require replacement with one that does .

(5) An individual repair that does not meet the criteria of 'B' or 'A' repairs, inspection personnel would need to perform a high frequency eddy current inspection of the rows of fasteners specified by the OEM for cracks. If cracks are found, repair would be replaced with a new "B" or "A" category repair.

(6) All records of findings and repairs would be required to be documented per normal maintenance practices. No special reporting requirements are required.

(7) New repairs would be installed per revised OEM SRM's or OEM model specific guidance material.

(b) The procedure above will be repeated at each heavy maintenance visit.

Example 3. The following example illustrates an acceptable program where repair categorization occurs at a implementation time and the actual repair inspection occurs at a later time.

(a) Implementation. Enter into the model specific Approved Maintenance Schedule a rule requiring the repair survey at what ever implementation time is applicable for that model airplane.

(b) Categorization. Inspection for repairs would be by routine card packaged onto the appropriate airplane check by maintenance planning. A defect card would be raised against each repair which in turn would require the assessment to be carried out by airline engineering personnel trained in the assessment procedure. The airline personnel would be required to fill out the assessment form, complete the assessment and repair categorization accordingly. A copy of the completed form would be attached to the defect card as a means of clearing assessment requirements. The two forms would then be placed in the permanent airplane maintenance log. After categorization the engineering personnel would be responsible for establishing method and frequency of inspections and entering them into the approved maintenance schedule (AMS).

(c) Control of Inspections and replacement times. Control for 'B' or 'C' category repairs would be controlled via the AMS. In certain circumstances, details of category 'C' repairs that have a restricted life limit may be entered into the Deferred Maintenance section of the Airplane Log book until the repair is replaced at or before reaching the life limit.

7.0 Proposed Notice of Proposed Rulemaking

7.1 Introduction

The following Notice of Proposed Rulemaking (NPRM) has been reviewed by the FAA. This review included legal, technical content and economic considerations. The technical content has been reviewed by both Aircraft Certification and Flight Standards offices. Comments from all FAA reviews have been incorporated into the text of the NPRM.

7.2 Rule Viewpoint

The viewpoint of this NPRM is from the aspect that all necessary OEM documentation needed to accomplish the rule has been approved and issued. This viewpoint will exist at the time of rule codification but does not exist at the writing of this report. The goal is to complete the necessary SRM updates and model specific documents within one year of AAWG, ARAC and STG adoption of the recommendations contained here in but not later than one year prior to the effective date of the rule.

7.3 Proposed Rule Text

[4910-13] 12/12/96

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 91, 121, 125, and 129

[Docket No. ; Notice No.]

RIN 2120-

Repair Assessment for Pressurized Fuselages

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking.

SUMMARY: This proposed rulemaking would require incorporation of repair assessment guidelines for the fuselage pressure boundary (fuselage skins and bulkhead webs) of certain transport category airplane models into the FAA-approved maintenance or inspection program of each operator of those airplanes. This action is the result of concern for the continued operational safety of airplanes that are approaching or have exceeded their design service goal. The purpose of the repair assessment guidelines is to establish a damage-tolerance based supplemental inspection program for repairs to detect damage, which may develop in a repaired area, before that damage degrades the load carrying capability of the structure below the levels required by the applicable airworthiness standards.

DATES: Comments must be submitted on or before [insert date 90 days after date of publication]

ADDRESSES: Comments on this notice may be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC-200), Docket No. , 800 Independence Avenue SW., Washington DC 20591; or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington DC 20591. Comments delivered must be marked Docket No. . Comments may also be submitted electronically to: nprmcmts@dot.faa.gov. Comments may be examined in Room 915G weekdays, except Federal holidays, between 8:30 a. m. and 5:00 p. m. In addition, the FAA is maintaining an information docket of comments in the Transport Airplane Directorate (ANM-100), Federal Aviation Administration, Northwest Mountain Region, 1601

Lind Avenue SW., Renton, WA 98055-4056. Comments in the information docket may be examined weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

FOR FURTHER INFORMATION CONTACT: Dorenda Baker, Manager, Aging Aircraft Program, ANM-109, FAA Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, WA 98055-4056; telephone (206) 227-2109, facsimile (206) 227-1100.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in this proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy, federalism, or economic impact that might result from adoption of the proposals in this notice are also invited. Substantive comments should also be accompanied by cost estimates. Commenters should identify the regulatory docket or notice number and submit comments in triplicate to the Rules Docket address specified above. All comments received on or before the closing date for comments will be considered by the Administrator before taking action on this proposed rulemaking. The proposals contained in this notice may be changed in light of the comments received. All comments received will be available in the Rules Docket for examination by interested persons, both before and after the closing date for comments. A report summarizing each substantive public contact with FAA personnel concerned with this rulemaking will be filed in the docket. Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this notice must include a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. ." The postcard will be date stamped and returned to the commenter.

Availability of the NPRM

An electronic copy of this document may be downloaded using a modem and suitable communications software from the FAA regulations section of the Fedworld electronic bulletin board service (telephone: 703-321-3339), the online *Federal Register* database through GPO Access (telephone: 202-512-1661), or the FAA's Aviation Rulemaking Advisory Committee Bulletin Board service (telephone : 202-267-5948).

Internet users may reach the FAA's web page at http://www.faa.gov or GPO's *Federal Register* web page at http://www.access.gpo.gov/su_docs for access to recently published rulemaking documents.

Any person may obtain a copy of this NPRM by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM-1, 800 Independence Avenue SW., Washington, D.C. 20591, or by calling (202) 267-9677. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future rulemaking documents should request from the Office of Public Affairs, Attention: Public Inquiry Center, APA-230, 800 Independence Ave SW., Washington, D.C.

20591, or by calling (202) 267-3484, a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

Background

This proposal, to require the incorporation of repair assessment guidelines into the maintenance or inspection program for certain transport category airplanes, follows from commitments made by the FAA and the aviation community in June 1988 to address the issues concerning the safety of aging transport airplanes.

In April 1988, a high-cycle transport airplane enroute from Hilo to Honolulu, Hawaii, suffered major structural damage to its pressurized fuselage during flight. This accident was attributed in part to the age of the airplane involved. The economic benefit of operating certain older technology airplanes has resulted in the operation of many such airplanes beyond their previously projected retirement age. Because of the problems revealed by the accident in Hawaii and the continued operation of older airplanes, both the FAA and industry generally agreed that increased attention needed to be focused on the aging fleet and on maintaining its continued operational safety.

In June 1988, the FAA sponsored a conference on aging airplanes. As a result of that conference, an aging aircraft task force was established in August 1988 as a sub-group of the FAA's Research, Engineering, and Development Advisory Committee, representing the interests of the aircraft operators, aircraft manufacturers, regulatory authorities, and other aviation representatives. The task force, then known as the Airworthiness Assurance Task Force (AATF), set forth five major elements of a program for keeping the aging fleet safe. For each airplane model in the aging transport fleet, (1) select service bulletins describing modifications and inspections necessary to maintain structural integrity; (2) develop inspection and prevention programs to address corrosion; (3) develop generic structural maintenance program guidelines for aging airplanes; (4) review and update the Supplemental Structural Inspection Documents (SSID) which describe inspection programs to detect fatigue cracking; and (5) assess damage-tolerance of structural repairs. Structures Task Groups sponsored by the Task Force were assigned the task of developing these elements into usable programs.

Today the Task Force, which has been reestablished as the Airworthiness Assurance Working Group (AAWG) of the Aviation Rulemaking Advisory Committee (ARAC), has completed its work on the first four elements. This proposed rulemaking addresses the fifth element, the assessment of repair damage tolerance.

The Aviation Rulemaking Advisory Committee

The ARAC was formally established by the FAA on January 22, 1991 (56 FR 2190), to provide advice and recommendations concerning the full range of the FAA's safety-related rulemaking activity. This advice was sought to develop better rules in less overall time using fewer FAA resources than are currently needed. The committee provides the opportunity for the FAA to obtain firsthand information and insight from interested parties regarding proposed new rules or revisions of existing rules.

There are over 60 member organizations on the committee, representing a wide range of interests within the aviation community. Meetings of the committee are open to the public, except as authorized by section 10(d) of the Federal Advisory Committee Act.

The ARAC establishes working groups to develop proposals to recommend to the FAA for resolving specific issues. Tasks assigned to working groups are published in the *Federal Register*. Although working group meetings are not generally open to the public, all interested parties are invited to participate as working group members. Working groups report directly to the ARAC, and the ARAC must concur with a working group proposal before that proposal can be presented to the FAA as an advisory committee recommendation.

The activities of the ARAC will not, however, circumvent the public rulemaking procedures. After an ARAC recommendation is received and found acceptable by the FAA, the agency proceeds with the normal public rulemaking procedures. Any ARAC participation in a rulemaking package will be fully disclosed in the public docket.

By Federal Register notice dated November 30, 1992 (57 FR 56627), the AATF was placed under the auspices of the Aviation Rulemaking Advisory Committee (ARAC) and renamed as the Airworthiness Assurance Working Group. One of the specific tasks assigned to the AAWG was to develop recommendations concerning whether new or revised requirements and compliance methods for structural repair assessments of existing repairs should be initiated and mandated for the Airbus A300; BAC 1-11; Boeing 707/720, 727, 737, 747; Douglas DC-8, DC-9/MD-80, DC-10; Fokker F-28; and Lockheed L-1011 airplanes.

The Concern Posed By Older Repairs

The basic structure of each of the large jet transports that would be affected by this proposed rule was required at the time of original certification to meet the applicable regulatory standards for fatigue or fail-safe strength. Repairs and modifications to this structure were also required to meet these same standards.

These early fatigue or fail-safe requirements did not provide for timely inspection of critical structure so that damaged or failed components could be dependably identified and repaired or replaced before a hazardous condition developed. In 1978 a new certification requirement called damage tolerance was introduced to assure the continued structural integrity of transport category airplanes certificated after that time. This concept was adopted as an amendment to § 25.571 by Amendment 25-45 (43 FR 46242), and for existing designs, guidance material based on this rule was published in 1981 as Advisory Circular (AC) 91-56, Supplemental Structural Inspection Program for Large Transport Category Airplanes.

Damage-tolerance is a structural design and inspection methodology used to maintain safety considering the possibility of metal fatigue or other structural damage (i.e., safety is maintained by adequate structural inspection until the damage is repaired). The underlying principle for damage tolerance is that the initiation and growth of structural fatigue damage can be anticipated with sufficient precision to allow inspection programs to safely detect damage before it reaches a critical size. A damage-tolerance evaluation entails the prediction of sites where fatigue cracks are most likely to initiate in the airplane structure, the prediction of the crack trajectories and rates of growth under repeated airplane structural loading, the prediction of the size of the damage at which strength limits are exceeded, and an analysis of the potential opportunities for inspection of the damage as it progresses. This information is used to establish an inspection program for the structure that, if rigorously followed, will be able to detect cracking that may develop before it precipitates a major structural failure. A damage-tolerant structure is one in which damage would be detected by reliance on normally performed maintenance and inspection actions long before it becomes hazardous .

The evidence to date is that when all critical structure is included, the damage-tolerant concept, and the supplemental inspection programs that are based on it, provide the best assurance of continued structural integrity that is currently available. In order to apply this concept to existing transport airplanes, beginning in 1984, the FAA issued a series of Airworthiness Directives (AD's) requiring compliance with the first supplemental inspection programs resulting from application of this concept to existing airplanes. Nearly all of the airplane models affected by this proposed rule are now covered by such AD's. Generally, these AD's require that operators incorporate Supplemental Structural Inspection Documents (SSID's) into their maintenance programs for the affected airplanes. These documents were derived from damage tolerance assessments of the originally certificated type designs for these airplanes. For this reason, the majority of AD's written for the SID program did not attempt to address issues relating to the damage tolerance of repairs that had been made to the airplanes. The objective of this proposed rule is to provide that same level of assurance for areas of the structure that have been repaired.

Repairs are a concern on older airplanes because of the possibility that they may develop, cause, or obscure metal fatigue, corrosion, or other damage during service. This damage might occur within the repair itself or in the adjacent structure and might ultimately lead to structural failure. The damage-tolerance evaluation of a repair would be used in an assessment program to establish an appropriate inspection program, or a replacement schedule if the necessary inspection program is too demanding or not possible. The objective of the repair assessment is to assure the continued structural integrity of the repaired and adjacent structure based on damage-tolerance principles.

In general, repairs present a more challenging problem to solve than the original structure because they are unique and tailored in design to correct particular damage to the original structure. Whereas the performance of the original structure may be predicted from tests and from experience on other airplanes in service, the behavior of a repair and its effect on the fatigue characteristics of the original structure are generally not known to the same extent as for the basic unrepaired structure.

The available service record and surveys of out-of-service and in-service airplanes have indicated that existing repairs perform well. Although the cause of an airplane accident has never been attributed to properly applied repairs using the original repair data, repairs may be of concern as time-in-service increases for the following reasons:

1. As airplanes age, both the number and age of the existing repairs increase. Along with this increase in the number of and age of repairs is the possibility of unforeseen repair interaction, autogenous failure, or other damage occurring in the repaired area. The continued operational safety of these airplanes depends primarily on a satisfactory maintenance program (inspections conducted at the right time, in the right place, using the most appropriate technique). To develop this program, a damage tolerance evaluation of repairs to flight critical structure is essential. The longer an airplane is in service, the more important this evaluation and a subsequent inspection program become.

2. The practice of damage-tolerance methodology has evolved gradually over the last 20 plus years. Some repairs described in the airplane manufacturers' Structural Repair Manuals (SRMs) were not designed to current standards. Repairs accomplished in accordance with the information contained in the early versions of the SRMs may require additional inspections if evaluated using the current methodology.

3. Because a regulatory requirement for damage-tolerance was not applied to airplane designs type certificated before 1978, the damage-tolerance characteristics of repairs may vary widely and are largely unknown.

Development of Recommendation

To address the ARAC assignment on repairs, the AAWG tasked the manufacturers to develop repair assessment guidelines requiring specific maintenance programs to maintain the damage-tolerance integrity of the basic airframe. The following criteria were developed to assist the manufacturers in the development of that guidance material:

- Specific repair size limits for which no assessment is necessary should be selected for each model of airplane.
- Repairs that do not conform to SRM standards must be reviewed and may require further action.
- Repairs must be reviewed where the repair has been installed in accordance with SRM data that have been superseded or rendered inactive by new damage-tolerant designs.
- Repairs in close proximity to other repairs or modifications require review to determine their impact on the continued airworthiness of the airplane.
- Repairs that exhibit structural distress should be replaced before further flight.

To identify the scope of the overall program, fleet data were required. This resulted in the development of a five-step program to develop factual data for the development of the rule. The five-step AAWG program consisted of:

- Development of model specific repair assessment guidelines using AAWG repair criteria.

- Completion of a survey of a number of operators' airplanes to assess fuselage skin repairs, and to validate the approach of the manufacturer's repair assessment guidelines.
- Determination of the need for and the development of a world-wide survey.
- Collection and assessment of results to determine further necessary actions.
- Development of specific manufacturer/operator/FAA actions.

Early in the development of this task, each manufacturer began to prepare model specific repair assessment guidelines. When sufficiently developed, these draft guidelines were shared with the operators to get feedback on acceptability and suggestions for improvement. The operators stressed the need for commonality in approach and ease of use of the guidelines. They also expressed the need for guidelines that could be used on the shop floor without engineering assistance and without extensive training.

Meanwhile, the AAWG conducted two separate surveys of existing repairs on airplanes to collect necessary data. The first survey was conducted in March 1992 on certain large transport category airplanes being held in storage. Teams, comprised of engineering representatives from various organizations, including FAA's Aircraft Certification and Flight Standards offices, operators, and manufacturers, surveyed 356 external fuselage skin repairs on 30 airplanes of 6 types. Using repair classification criteria developed by the individual airplane manufacturers, the teams concluded that the general quality of the repairs appeared good. Forty percent of the repairs were adequate, requiring no supplemental inspections, and sixty percent needed a more comprehensive damage-tolerance based assessment, with the possibility that supplemental inspections might be needed. Some determining factors on the need for further assessment were the size of the repair and its proximity to other repairs. While the survey sample size was very small compared to the total population of transport airplanes type certificated prior to 1978, it provided objective information on the quality and damage-tolerance characteristics of existing airplane repairs.

In 1994, the AAWG requested that the manufacturers conduct a second survey on airplane repairs to validate the 1992 results and to provide additional information relative to the estimated cost of the assessment program. The manufacturers were requested to visit airlines operating their products and to conduct surveys on airplanes in heavy maintenance. An additional 35 airplanes were surveyed in which 695 repairs were evaluated. This survey was expanded to include all areas of the airframe. The evaluation revealed substantially similar results to the 1992 results in which forty percent of the repairs were classified as adequate, and sixty percent of the repairs required consideration for additional supplemental inspection during service. In addition, only a small number of repairs (less than 10 percent) were found on portions of the airframe other than the external fuselage skin.

The AAWG proposed that the repair assessment be initially limited to the fuselage pressure boundary (fuselage skins and bulkhead webs); if necessary, future rulemaking would address the remaining primary structure. This limitation is based on two considerations.

First, the fuselage is more sensitive to structural fatigue than other airplane structure because its normal operating loads are closer to its limit design loads. Stresses in a fuselage are primarily governed by the pressure relief valve settings of the environmental control system, and these are less variable from flight to flight than the gust or maneuver loads that typically determine the design stresses in other structure. Second, the fuselage is more prone to damage from ground service equipment than other structure and requires repair more often. The result of the second survey described above supports the conclusion that repairs to the fuselage are far more frequent than to any other structure.

This proposed rule would only apply to eleven large transport category airplane models. (In the original ARAC task, the 707 and 720 were counted as one model. This proposed rule addresses the 707 and 720 models separately due to their different flight cycle implementation times.) The reason for this limitation is that the original tasking to the ARAC limited the scope of the work to the eleven oldest models of large transport category airplanes then in regular service. This tasking identified those airplanes for which the greatest concern exists as to the status of primary structure repairs. Derivatives of the original airplane models are covered to the extent that the structure has not been upgraded to meet damage tolerance requirements.

Those transport category airplanes that have been certificated to regulatory standards that include the requirements for damage tolerant structure under § 25.571 of 14 CFR part 25, as amended by Amendment 25-45, are not included. These later requirements make it incumbent on the operating certificate holder to return the structure to the original certification basis by installing only those repairs that meet the airplane's damage-tolerant certification basis. The AAWG, in its final report on this subject, did recommend continued monitoring of repairs on the newer airplanes, with the possibility of additional rulemaking if conditions warrant. (A copy of the AAWG's final report is included in the public docket for this rulemaking.)

As a result of the AAWG activities, the manufacturers have recognized the need for, and made a commitment to develop, for each affected airplane model, a repair assessment guidelines document and a Structural Repair Manual, updated to include the results of a damage-tolerance assessment. When referring to these documents and related actions in this proposed rule, the FAA is referring to actions the manufacturers have agreed to take.

It was also recognized by the AAWG that repair assessment guidelines would add to, or in some cases appear to be in conflict with, existing repair approval data. All repairs assessed under this proposed rule should have been previously approved by the FAA using an FAA-approved SRM, an FAA-approved Service Bulletin, or a repair scheme approved by an FAA Designated Engineering Representative or an SFAR 36 authorization holder. To avoid the appearance of conflicts between FAA approved data sources, the manufacturers have agreed to update the affected SRMs, as well as repairs identified in Service Bulletins, to determine requirements for supplemental inspections, if not already addressed.

Structural modifications and repairs mandated by Airworthiness Directives do not always contain instructions for future supplemental inspection requirements. The manufacturers have agreed to evaluate the need for post modification inspections for these mandated modifications and repairs. A list of Service Bulletins that are the subject of Airworthiness Directives will be contained in the model specific repair assessment guidelines, with required post modification/repair inspection programs as required. A list of other structural Service Bulletins will be provided in the model specific repair assessment guidelines with associated inspection thresholds and repeat intervals. The manufacturers have agreed to complete their review of Service Bulletin related skin repairs in conjunction with the initial SRM updates.

These agreements notwithstanding, there is still a possibility that the requirements in the repair assessment guidelines will not agree with that in an AD, especially if the AD was written to address a modification to the airplane made by someone other than the original manufacturer. Federal Aviation Regulations would require that compliance be shown with both the AD and this proposed rule. Such dual compliance can be avoided in the longer term by working with the manufacturer, if that is the source of difficulty, or by securing an Alternative Method of Compliance (AMOC) to the AD. In the short term, compliance with the earlier threshold, shorter repeat inspection interval or more stringent rework/replace schedule would always constitute compliance with the less stringent requirement. Thus, the operator would not be faced with an unresolvable conflict.

The AATF originally recommended that the use of repair assessment guidelines be mandated by Airworthiness Directive. The FAA concluded that an unsafe condition necessitating AD action had not been established for repairs, and this position is supported by both repair surveys. However, the FAA also considered, and the AAWG agreed, that the long term concern with repairs on older airplanes, as described earlier, does warrant regulatory action, and this proposed rule addresses that concern.

The AAWG also recognized that the concerns discussed above for the safety of existing repairs would also apply to the long-term safety of future repairs to these airplanes. Therefore, the AAWG considered that new repairs should also be subject to damage-tolerance assessments. It is expected that most new repairs will be installed in accordance with an FAA-approved SRM that has been updated to include this damage-tolerance assessment. However, in the event that a new repair is installed for which no such assessment has been made, or is available, the repair assessment guidelines prepared to meet the requirements of this proposal should be used. The intent of this proposed rule is that all repairs to the fuselage pressure boundary will be evaluated for damage-tolerance, and that any resulting inspection schedule will be specified and the work accomplished, regardless of when, where, or by whom the repair was installed.

Repair Assessment Guidelines

The next step in the AAWG's program for this task was to develop a repair assessment methodology that is effective in evaluating the continued airworthiness of existing repairs for the fuselage pressure boundary on affected transport category airplane models. Older airplane models may have many structural repairs, so the efficiency of the assessment procedure is an important consideration. In the past, evaluation of repairs for damage-tolerance would require direct assistance from the manufacturer. Considering that each repair design is different, that each airplane model is different, that each area of the airplane is subjected to a different loading environment, and that the number of engineers qualified to perform a damage-tolerance assessment is small, the size of an assessment task conducted in that way would be unmanageable. Therefore, a new approach was developed.

Since repair assessment results will depend on the model specific structure and loading environment, the manufacturers were tasked to create an assessment methodology for the types of repairs expected to be found on each affected airplane model. Since the records on most of these repairs are not readily available, locating the repairs will necessitate surveying the structure of each airplane. A survey form was created that may be used to record key repair design features needed to accomplish a repair assessment. Airline personnel not trained as damage-tolerance specialists can use the form to document the configuration of each observed repair.

Using the information from the survey form as input data, the manufacturers have developed simplified methods to determine the damage tolerance characteristics of the surveyed repairs. Although the repair assessments should be performed by well trained personnel familiar with the model specific repair assessment guidelines, these methods enable an engineer or technician, not trained as a damage-tolerance specialist, to perform the repair assessment without the assistance of the manufacturer.

From the information on the survey form, it is also possible to classify repairs into one of three categories:

Category A: A permanent repair for which the baseline zonal inspection (BZI), (typical maintenance inspection intervals assumed to be performed by most operators), is adequate to ensure continued airworthiness (inspectability) equal to the unrepaired surrounding structure.

Category B: A permanent repair that requires supplemental inspections to ensure continued airworthiness.

Category C: A temporary repair that will need to be reworked or replaced prior to an established time limit. Supplemental inspections may be necessary to ensure continued airworthiness prior to this limit.

This methodology is being generated by the airplane manufacturers. Model specific repair assessment guidelines will be prepared by the manufacturers for the eleven aging airplane models. Uniformity and similarity of these repair assessment procedures between models is important to simplify operator workload. The manufacturers have spent considerable time over the last four years to achieve commonality of the repair assessment process. The inspection intervals contained in the FAA-approved model specific guidelines documents are based on residual strength, crack growth, and inspectability evaluations. The manufacturers are endeavoring to make the inspection methods and intervals compatible with typical operator maintenance practice. Thus, internal inspections would be acceptable at "D-check" intervals, or equivalent cycle limit, while simpler external inspections could be accommodated at multiple "C-check" intervals, or equivalent cycle limit. If the inspection method and intervals for a given repair are not compatible with the operator's maintenance schedule, the repair could be replaced with a more damage-tolerant repair.

The model specific repair assessment guidelines documents are scheduled to be published no later than July 1, 1997, and will require approval by the FAA Aircraft Certification Office (ACO) having cognizance over the type certificate. Once approved, this material can also be used for evaluating the damage-tolerance characteristics of new repairs for continued airworthiness.

In order to further facilitate the assessment process, the manufacturers have agreed to update model specific SRMs to reflect damage tolerance repair considerations. The goal is to complete these updates by the first revision cycle of the model specific SRM, after the release of the associated repair assessment guidelines document. Consistent with the results of the surveys, only fuselage pressure boundary repairs are under consideration in this proposal.

The general section of each SRM, Chapter 51, will contain brief descriptions of damage tolerance considerations, categories of repairs, description of baseline zonal inspections, and the repair assessment logic diagram. Chapter 53 of the SRM for pressurized fuselage skin will be updated to identify repair categories and related information.

In updating each SRM, existing location-specific repairs should be labeled with appropriate repair category identification (A, B, or C), and specific inspection requirements for B and C repairs should also be provided as applicable.

Structural Repair Manual descriptions of generic repairs will also contain repair category considerations regarding size, zone, and proximity. Detailed information for determination of inspection requirements will be provided in separate repair assessment guidelines documents for each model. Repairs which were installed in accordance with a once current SRM, but which have now been superseded by a new damage-tolerant design, will require review. Such superseded repairs may be reclassified to Category B or C, requiring additional inspections and/or rework.

Repair Assessment Process

There are two principle techniques that can be used to accomplish the repair assessment. The first technique involves a three stage procedure. This technique could be well suited for operators of small fleets. The second technique involves the incorporation of the repair assessment guidelines as part of an operator's routine maintenance program. This approach could be well suited for operators of large fleets and would evaluate repairs at predetermined planned maintenance visits as part of the maintenance program. Manufacturers and operators may develop other techniques, which would be acceptable as long as they fulfill the objectives of this proposed rule, and are FAA approved.

The first technique generally involves the execution of the following three stages:

Stage 1--Data Collection

This stage specifies what structure should be assessed for repairs and collects data for further analysis. If a repair is on a structure in an area of concern, the analysis continues, otherwise the repair does not require classification per this program.

Repair assessment guidelines for each model will provide a list of structure for which repair assessments are required. Some manufacturers have reduced this list by determining the inspection requirements for critical details. If the requirements are equal to normal maintenance checks (e.g., BZI checks), those details were excluded from this list.

Repair details are collected for further analysis in Stage 2. Repairs that do not meet the static strength requirements or are in a bad condition are immediately identified, and corrective actions must be taken before further flight.

Stage 2--Repair Categorization

The repair categorization is accomplished by using the data gathered in Stage 1 to answer simple questions regarding structural characteristics.

If the maintenance program is at least as rigorous as the BZI identified in the manufacturer's model specific repair assessment guidelines, well designed repairs in good condition meeting size and proximity requirements are Category A. Simple condition and design criteria questions are provided in Stage 2 to define the lower bounds of Category B and Category C repairs. The process continues for Category B and C repairs.

Stage 3--Determination of Structural Maintenance Requirements

The supplemental inspection and/or replacement requirements for Category B and C repairs are determined in this stage. Inspection requirements for the repair are determined by calculation or by using predetermined values provided by the manufacturer, or other values obtained using an FAA-approved method.

In evaluating the first supplemental inspection, Stage 3 will define the inspection threshold in flight cycles measured from the time of repair installation. If the time of installation of the repair is unknown and the airplane has exceeded the assessment implementation times or has exceeded the time for first inspection, the first inspection should occur by the next "C-check" interval, or equivalent cycle limit after the repair data is gathered (Stage 1).

An operator may choose to accomplish all three stages at once, or just Stage 1. In the latter case, the operator would be required to adhere to the schedule specified in the FAA-aproved model specific repair assessment guidelines for completion of Stages 2 and 3.

Incorporating the maintenance requirements for Category B and C repairs into an operator's individual airplane maintenance or inspection program completes the repair assessment process for the first technique.

The second technique would involve setting up a repair maintenance program to evaluate all fuselage pressure boundary repairs at each predetermined maintenance visit to confirm that they are permanent. This technique would require the operator to choose an inspection method and interval in accordance with the FAA-approved repair assessment guidelines. The repairs whose inspection requirements are fulfilled by the chosen inspection method and interval would be inspected in accordance with the regular FAA-approved maintenance program. Any repair that is not permanent, or whose inspection requirements are not fulfilled by the chosen inspection method and interval, would either be: (1) upgraded to allow utilization of the chosen inspection method and interval, or (2) individually tracked to account for the repair's unique inspection method and interval requirements. This process is then repeated at the chosen inspection interval.

Repairs added between the predetermined maintenance visits, including interim repairs installed at remote locations, would be required either to have a threshold greater than the length of the predetermined maintenance visit or to be tracked individually to account for the repair's unique inspection method and interval requirements. This would ensure the airworthiness of the structure until the next predetermined maintenance visit, at which time the repair would be evaluated as part of the repair maintenance program.

Whichever technique is used, there may be some repairs that cannot easily be upgraded to Category A for cost, downtime, or technical reasons. Such repairs will require supplemental inspections, and each operator should make provisions for this when incorporating the repair assessment guidelines into its maintenance program.

Repair Assessment Implementation Time

The implementation time for the assessment of existing repairs is based on the findings of the repair surveys and fatigue damage considerations. The repair survey findings indicated that all repairs reviewed appeared to be in good structural condition. This tended to validate the manufacturer's assumptions in designing both the repair and the basic structure. Since the manufacturer had based the design stress levels on a chosen Design Service Goal (DSG), it was concluded that the repair assessment needed to be implemented sometime before a specific model reached its DSG. Based on this logic, the manufacturers and operators established an upper bound for an assessment to be completed and then reduced it to establish an "implementation time," defined as 75 percent of DSG in terms of flight cycles.

Therefore, under this approach, incorporation of the repairs assessment guidelines into an airplane's maintenance or inspection program ideally should be accomplished before an airplane accumulates 75 percent of DSG. After the guidelines are incorporated into the maintenance or inspection program, operators should begin the assessment process for existing fuselage repairs within the flight cycle limit specified in the FAA-approved model specific repair assessment guidelines. There are three deadlines for beginning the repair assessment process, depending on the cycle age of the airplane on the effective date of the rule.

1. Airplane cycle age equal to or less than implementation time on the rule effective date. The operator would be required to incorporate the guidelines in its maintenance or inspection program by the flight cycle implementation time, or one year after the effec-

tive date of the rule, whichever occurs later. The assessment process would begin (e.g., accomplishment of Stage 1) on or before the cycle limit specified in the repair assessment guidelines (generally equivalent to a 'D' check) after incorporation of the guidelines.

2. Airplane cycle age greater than the implementation time but less than the DSG on the rule effective date. The operator would be required to incorporate the guidelines in its maintenance or inspection program within one year of the rule effective date. The assessment process would begin (e.g., accomplishment of Stage 1) on or before the cycle limit in the repair assessment guidelines (generally equivalent to a 'D' check), not to exceed the cycle limit computed by adding the DSG to the cycle limit equivalent of a 'C' check (also specified in the repair assessment guidelines) after incorporation of the guidelines.

3. Airplane cycle age greater than the DSG on the rule effective date. The operator would be required to incorporate the guidelines in its maintenance or inspection program within one year of the rule effective date. The assessment process would begin (e.g., accomplishment of Stage 1) on or before the cycle limit specified in the repair assessment guidelines (equivalent to a 'C' check) after incorporation of the guidelines.

In each of these three cases, the assessment process would have to be completed, the inspections conducted, and any necessary corrective action taken, all in accordance with the schedule specified in the FAA-approved repair assessment guidelines.

Discussion of the Proposed Rule

This proposed rule is intended to ensure that a comprehensive repairs assessment for damage-tolerance be completed for fuselage pressure boundary repairs, and that the resulting inspections, modifications and corrective actions (if any) be accomplished in accordance with the model specific repair assessment guidelines. To comply with this, the operator would need to consider the following:

1. The means by which the FAA-approved repair assessment guidelines are incorporated into a certificate holder's FAA-approved maintenance or inspection program, as would be required by the proposed rule, is subject to approval by the certificate holder's principal maintenance inspector (PMI) or other cognizant airworthiness inspector.

2. The repair assessment guidelines must be approved by the FAA Aircraft Certification Office (ACO) having cognizance over the type certificate of the airplane.

3. This rule would not impose any new reporting requirements; however, normal reporting required under 14 CFR § 121.703 would still apply.

4. This rule would not impose any new FAA recordkeeping requirements. However, as with all maintenance, the current operating regulations (e.g., 14 CFR § 121.380) already impose recordkeeping requirements that would apply to the actions required by this proposed rule. When incorporating the repair assessment guidelines into its approved maintenance program, each operator should address the means by which it will comply with these recordkeeping requirements. That means of compliance, along with the remainder of the program, would be subject to approval by the cognizant PMI or other cognizant airworthiness inspector.

5. The scope of the assessment is limited to repairs on the fuselage pressure boundary (fuselage skins and bulkhead webs).

a. A list of Service Bulletins that are the subject of AD's will be contained in the model specific repair assessment guidelines with required post modification/repair inspection programs, as required.

b. A list of other structural Service Bulletins will be provided in the model specific repair assessment guidelines with associated inspection threshold and repeat intervals.

6. The repair assessment guidelines provided by the manufacturer do not generally apply to structure modified by a Supplemental Type Certificate (STC). The operator, however, would still be responsible, under this proposed rule, to provide repair assessment guidelines applicable to the entire fuselage external pressure boundary that meets the program objectives specified in Advisory Circular 121-XX. This means that the operator should develop, submit, and gain FAA approval of guidelines to evaluate repairs to such structure.

It is recognized that operators do not usually have the resources to determine a DSG or to develop repair assessment guidelines, even for a very simple piece of structure. The FAA expects the STC holder to assist the operators in preparing the required documents. If the STC holder is out of business, or is otherwise unable to provide assistance, the operator would have to acquire the FAA-approved guidelines independently. To keep the airplanes in service, it is always possible for operators, individually or as a group, to hire the necessary expertise to develop and gain approval of repair assessment guidelines and the associated DSG. Ultimately, the operator remains responsible for the continued safe operation of the airplane.

The cost and difficulty of developing guidelines for modified structure may be less than that for the basic airplane structure for three reasons. First, the only modifications made by persons other than the manufacturer that are of concern in complying with this proposed rule are those that affect the fuselage pressure boundary. Of those that do affect this structure, many are small enough to qualify as Category A repairs under the repair assessment guidelines, based solely on their size. Second, if the modified structure is identical, or very similar, to the manufacturer's original structure, then only a cursory investigation may be necessary. In such cases, the manufacturer's repair assessment guidelines may be shown to be applicable with few, if any, changes. If the operator determines that a repair to modified structure can be evaluated using the manufacturer's model specific repair assessment guidelines, that determination should be documented and submitted to the operator's PMI or other cognizant airworthiness inpector for approval. For all other repairs, a separate program would need to be developed. Third, the modification may have been made so recently that no repair assessment guidelines would be needed for many years. Compliance with this proposed rule could be shown by establishing the DSG for the new modified structure, calculating an implementation time that is equal to three quarters of that DSG, and then adding a statement to the operations specifications that repair assessment guidelines would be incorporated into the maintenance program by that time. If the modified structure is very similar to the original, then the DSG for the modified structure may also be very similar. No repair assessment guidelines would be needed until 75 percent of that goal is reached. For example, in the case of a large cargo door, such installations are often made after the airplane has reached the end of its useful life as a passenger-carrying airplane. For new structure, the clock would start on repair assessment at the time of installation. Further, since the DSG is measured in cycles, and cargo operation usually entails fewer operational cycles than passenger operations, the due date for incorporation of the repair assessment guidelines for that structure could be many years away.

Compliance with this proposed rule would require that conditions such as those described above be properly documented in each operator's FAA-approved maintenance program; however, the cost of doing so should not be significant. There should be very few examples where the STC holder is unavailable, and the operators must bear the cost of developing a complete repair assessment guidelines document. Guidance on how to comply with this aspect of the proposed rule is also discussed in the accompanying Advisory Circular 121-XX.

7. An operator's repair assessment program would have to include damage-tolerance assessments for new repairs. Repairs made in accordance with the revised version of the SRM would already have a damage-tolerance assessment performed; otherwise, the manufacturer's repair assessment guidelines could be used for this purpose, or operators may develop other methods as long as they achieve the same objectives.

8. Once the airworthiness inspector having oversight responsibilities is satisfied that the operator's continued airworthiness maintenance or inspection program contains all of the elements of the FAA-approved repair assessment guidelines, the airworthiness inspector would approve an operation specification(s) or inspection program revision. This would have the effect of requiring use of the approved repair assessment guidelines.

In summary, based on discussions with representatives of the affected industry, recommendations from ARAC, and a review of current rules and regulations affecting repair of primary structure, the FAA recognizes the need for a repairs assessment program to be incorporated into the maintenance program for certain transport category airplanes.

The proposed rule would prohibit the operation of certain transport category airplanes operated under 14 CFR Parts 91, 121, 125, and 129 beyond a specified compliance time, unless the operator of those airplanes had incorporated FAA-approved repair assessment guidelines applicable to the fuselage pressure boundary in its operation specification(s) or approved inspection program, as applicable.

FAA Advisory Material

In addition to the amendments proposed in this notice, the ARAC has developed Advisory Circular 121-XX, "Repair Assessment of Pressurized Fuselages." This AC would provide guidance for operators of the affected transport category airplanes on how to incorporate FAA-approved repair assessment guidelines into their FAA-approved maintenance or inspection program. Public comments concerning the proposed AC are invited by separate notice published elsewhere in this issue of the *Federal Register*

International Civil Aviation Organization (ICAO) and Joint Aviation Regulations

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to comply with ICAO Standards and Recommended Practices to the maximum extent practicable. The FAA has determined that this proposed rule would not conflict with any international agreement of the United States.

Paperwork Reduction Act

There are no new requirements for information collection associated with this proposed rule that would require approval from the Office of Management and Budget pursuant to the Paperwork Reduction Act of 1980 (Pub. L. 96-511).

Regulatory Evaluation

Changes to federal regulations must undergo several economic analyses. First, Executive Order 12866 directs Federal agencies to promulgate new regulations or modify existing regulations only if the potential benefits to society justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Finally, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these assessments, the FAA has determined that this proposed rule: (1) would generate benefits exceeding its costs and is not "significant" as defined in Executive Order 12866; (2) is not "significant" as defined in DOT's Policies and Procedures; (3) would not have a significant impact on a substantial number of small entities; and (4) would not constitute a barrier to international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

Costs and Benefits

The proposed rule would result in costs to the manufacturers and operators of the affected airplanes and to the FAA. Costs to manufacturers would include revising the Structural Repair Manuals, developing repair assessment guidelines, and developing and conducting training programs for Original Equipment Manufacturers' engineers, airplane operators' inspectors, and the FAA's PMIs or other cognizant airworthiness inspector. Costs to operators would include inspector training, integrating the assessment program into the maintenance program for each airplane model, assessing and subsequently inspecting repairs, and maintaining records. Costs to the FAA would include PMI/other cognizant airworthiness inspector training and review/approval of assessment programs.

The FAA estimates that the total cost to all affected manufacturers would be $43.3 million over the years 1995 through 2020, or $26.9 million discounted to present value. The equivalent annualized cost would be $2.3 million. Although this proposed rule would not directly impose any costs on manufacturers, the FAA recognizes that manufacturers have incurred, and will continue to incur, costs in order to develop and provide data to operators that will enable them to comply with the proposal. The FAA has chosen to attribute these costs to the proposed rule, beginning in 1995. The total cost to airplane operators would be $25.5 million over the years 1997 through 2020, or $10.2 million discounted to present value. The equivalent annualized cost would be $893,622. The total costs to the FAA would be $516,000, or $324,358 discounted to present value. The equivalent annualized cost would be $28,280. The total cost of the proposed rule to all affected entities would be $69.3 million, or $37.5 million discounted to present value. The equivalent annualized cost would be $3.2 million.

The cause of an airplane accident has never been attributed to a properly applied repair to the airplane models that would be affected by the proposed rule. Nevertheless, airplanes designed and certificated to older technology are operated beyond their original design service objectives, and the FAA has determined that the repair assessment program to ensure the continued airworthiness of these aging airplanes could prevent structural failure and resulting accidents. The benefits of the proposed rule, therefore, are based on the avoidance of such accidents.

The FAA estimates that the prevention of an accident resulting in the loss of an average affected airplane and half its passengers and crew would result in present value benefits of $46.8 million, assuming that the accident would otherwise have occurred mid-way through the analysis period. The FAA cannot predict the number of accidents that would be prevented by this proposed rule. Based on one such prevented loss, however, the FAA has determined that the proposed rule would be cost-beneficial.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires a Regulatory Flexibility Analysis if the proposed or final rule would have a significant economic impact, either detrimental or beneficial, on a substantial number of small entities. FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, prescribes standards for complying with RFA review requirements in FAA rulemaking actions. The Order defines "small entities" in terms of thresholds, "significant economic impact" in terms of annualized cost thresholds, and "substantial number" as a number which is not less than eleven and which is more than one-third of the small entities subject to the proposed or final rule.

The proposed rule would affect Boeing Commercial Airplane Group, Douglas Aircraft Company, Lockheed Aeronautical Systems Company, Airbus, British Aerospace, and Fokker Aircraft B. V. Order 2100.14A specifies a size threshold for classification as a small manufacturer as 75 or fewer employees. Since none of these manufacturers has 75 or fewer employees, the proposed rule would not have a significant economic impact on a substantial number of small manufacturers.

The proposed rule would also affect operators of certain U.S.-registered B707/720, B727, B737, B747, DC-8, DC-9/MD80, DC-10, L-1011, A300, BAC 1-11, and F28 airplanes. Order 2100.14A specifies a size threshold for classification as a small operator as ownership of 9 or fewer aircraft. The annualized cost thresholds for significant impact, expressed in 1995 dollars, are $119,900 for a scheduled air carrier whose fleet of airplanes have seating capacities of over 60, $67,000 for other scheduled air carriers, and $4,700 for an unscheduled operator. The FAA examined the annualized costs of the proposed rule to "small" operators of the current fleet of affected airplanes and determined that no small operator's annualized cost would exceed the threshold of $4,700. Therefore, the proposed rule would not have a significant impact on a substantial number of small operators.

International Trade Impact Assessment

The proposed rule would not constitute a barrier to international trade, including the export of American airplanes to foreign countries and the import of foreign airplanes into the United States.

Federalism Implications

The regulations proposed herein will not have substantial direct effects on the States, or on the relationship between the national government and the States, or on the distribution of power and responsibility among the various levels of the government. Therefore, in accordance with Executive Order 12612, it is determined that this proposed rule would not have significant federalism implications to warrant the preparation of a Federalism Assessment.

Conclusion

Because the proposed repair assessment programs are not expected to result in substantial economic cost, the FAA has determined that this proposed regulation is not a significant regulatory action under Executive Order 12866. The FAA has also determined that this proposal is not significant under DOT Regulatory Policies and Procedures (44 FR 11034, February 25, 1979). In addition, the FAA certifies that this proposal, if adopted, will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act, since none are affected. An initial evaluation of this proposal, including a Regulatory Flexibility Determination and an International Trade Impact Analysis, has been placed in the docket. A copy may be obtained by contacting the person identified under the caption **FOR FURTHER INFORMATION CONTACT**.

List of Subjects

14 CFR Part 91

Maintenance, Rebuilding, Pressurized Fuselage Repair and Alteration

14 CFR Part 121

Air carriers, Aircraft, Aviation Safety, Pressurized Fuselage Repair Assessment, Safety, Transportation

14 CFR Part 125

Air carriers, Aircraft, Aviation Safety, Pressurized Fuselage Repair Assessment, Safety, Transportation

14 CFR Part 129

Air carriers, Aircraft, Aviation Safety, Pressurized Fuselage Repair Assessment, Safety, Transportation

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend 14 CFR parts 91, 121, 125, and 129 of the Federal Aviation Regulations as follows:

PART 91 - GENERAL OPERATING AND FLIGHT RULES

1. The authority citation for part 91 continues to read as follows:

Authority: 49 U.S.C. app. 1301(7), 1303, 1344, 1348, 1352-1355, 1401, 1421-1431, 1471, 1472, 1502, 1510, 1522, and 2121-2125; Articles 12, 29, 31, and 32(a) of the Convention on International Civil Aviation (61 Stat. 1180); 42 U.S.C. 4321 *et seg.;* E.O. 11514; 49 U.S.C. 106(g)

2. A new § 91.XXX is added to read as follows:

* * * * *

§ 91.XXX Repair assessment for pressurized fuselages.

No certificate holder may operate an Airbus Model A300, British Aerospace Model BAC 1-11, Boeing Model 707,720, 727, 737 or 747, McDonnell Douglas Model DC-8, DC-9/MD-80 or DC-10, Fokker Model F28, or Lockheed Model L-1011 airplane beyond the applicable flight cycle implementation time specified below, or [a date one year after the effective date of the amendment], whichever occurs later, unless repair assessment guidelines applicable to the fuselage pressure boundary (fuselage fuselage skins and bulkhead webs) that have been approved by the FAA Aircraft Certification Office (ACO) having cognizance over the type certificate for the affected airplane are incorporated within its inspection program:

(a) For the A300, the flight cycle implementation time is:

(1) Model B2, 36,000 flights.

(2) Model B4-100, 30,000 flights above the window line, and 36,000 flights below the window line.

(3) Model B4-200, 25,500 flights above the window line, and 34,000 flights below the window line.

(b) For all models of the BAC 1-11, the flight cycle implementation time is 60,000 flights.

(c) For all models of the Boeing 707, the flight cycle implementation time is 15,000 flights.

(d) For all models of the Boeing 720, the flight cycle implementation time is 23,000 flights.

(e) For all models of the Boeing 727, the flight cycle implementation time is 45,000 flights.

(f) For all models of the Boeing 737, the flight cycle implementation time is 60,000 flights.

(g) For all models of the Boeing 747, the flight cycle implementation time is 15,000 flights.

(h) For all models of the Douglas DC-8, the flight cycle implementation time is 30,000 flights.

(i) For all models of the Douglas DC-9/MD-80, the flight cycle implementation time is 60,000 flights.

(j) For all models of the Douglas DC-10, the flight cycle implementation time is 30,000 flights.

(k) For all models of the Lockheed L-1011, the flight cycle implementation time is 27,000 flights.

(l) For the Fokker F-28 Mark 1000, 1000C, 2000, 3000, 3000C, and 4000, the flight cycle implementation time is 60,000 flights.

PART 121 - CERTIFICATION AND OPERATIONS: DOMESTIC, FLAG, AND SUPPLEMENTAL AIR CARRIERS AND COMMERCIAL OPERATORS OF LARGE AIRCRAFT.

1. The authority citation for part 121 continues to read as follows:

Authority: 49 U.S.C. app. 1354(a), 1355, 1356, 1357, 1401, 1421-1430, 1472, 1485, and 1502; 49 U.S.C. 106(g)

2. A new § 121.XXX is added to read as follows:

* * * * *

§ 121.XXX Repair assessment for pressurized fuselages.

No certificate holder may operate an Airbus Model A300, British Aerospace Model BAC 1-11, Boeing Model 707, 720, 727, 737 or 747, McDonnell Douglas Model DC-8, DC-9/MD-80 or DC-10, Fokker Model F28, or Lockheed Model L-1011 airplane beyond the applicable flight cycle implementation time specified below, or [a date one year after the effective date of the amendment], whichever occurs later, unless its operation specifications have been revised to reference repair assessment guidelines applicable to the fuselage pressure boundary (fuselage fuselage skins and bulkhead webs), and those guidelines are incorporated in its maintenance program. The repair assessment guidelines must be approved by the FAA Aircraft Certification Office (ACO) having cognizance over the type certificate for the affected airplane.

(a) For the A300, the flight cycle implementation time is:

(1) Model B2, 36,000 flights.

(2) Model B4-100, 30,000 flights above the window line, and 36,000 flights below the window line.

(3) Model B4-200, 25,500 flights above the window line, and 34,000 flights below the window line.

(b) For all models of the BAC 1-11, the flight cycle implementation time is 60,000 flights.

(c) For all models of the Boeing 707, the flight cycle implementation time is 15,000 flights.

(d) For all models of the Boeing 720, the flight cycle implementation time is 23,000 flights.

(e) For all models of the Boeing 727, the flight cycle implementation time is 45,000 flights.

(f) For all models of the Boeing 737, the flight cycle implementation time is 60,000 flights.

(g) For all models of the Boeing 747, the flight cycle implementation time is 15,000 flights.

(h) For all models of the Douglas DC-8, the flight cycle implementation time is 30,000 flights.

(i) For all models of the Douglas DC-9/MD-80, the flight cycle implementation time is 60,000 flights.

(j) For all models of the Douglas DC-10, the flight cycle implementation time is 30,000 flights.

(k) For all models of the Lockheed L-1011, the flight cycle implementation time is 27,000 flights.

(l) For the Fokker F-28 Mark 1000, 1000C, 2000, 3000, 3000C, and 4000, the flight cycle implementation time is 60,000 flights.

PART 125 - CERTIFICATION AND OPERATIONS: AIRPLANES HAVING A SEATING CAPACITY OF 20 OR MORE PASSENGERS OR A MAXIMUM PAYLOAD CAPACITY OF 6,000 POUNDS OR MORE

1. The authority citation for part 125 continues to read as follows:

Authority: 49 U. S. C. app. 1354, 1421-1430, 1472, 1485, and 1502; 49 U. S. C. 106(g)

2. A new § 125.XXX is added to read as follows:

* * * * *

§ 125.XXX repair assessment for pressurized fuselages.

No certificate holder may operate an Airbus Model A300, British Aerospace Model BAC 1-11, Boeing Model 707, 720, 727, 737 or 747, McDonnell Douglas Model DC-8, DC-9/MD-80 or DC-10, Fokker Model F28, or Lockheed Model L-1011 beyond the applicable flight cycle implementation time specified below, or [a date one year after the effective date of the amendment], whichever occurs later, unless its operation specifications have been revised to reference repair assessment guidelines applicable to the fuselage pressure boundary (fuselage fuselage skins and bulkhead webs), and those guidelines are incorporated in its maintenance program. The repair assessment guidelines must be approved by the FAA Aircraft Certification Office (ACO) having cognizance over the type certificate for the affected airplane.

(a) For the A300, the flight cycle implementation time is:

(1) Model B2, 36,000 flights.

(2) Model B4-100, 30,000 flights above the window line, and 36,000 flights below the window line.

(3) Model B4-200, 25,500 flights above the window line, and 34,000 flights below the window line.

(b) For all models of the BAC 1-11, the flight cycle implementation time is 60,000 flights.

(c) For all models of the Boeing 707, the flight cycle implementation time is 15,000 flights.

(d) For all models of the Boeing 720, the flight cycle implementation time is 23,000 flights.

(e) For all models of the Boeing 727, the flight cycle implementation time is 45,000 flights.

(f) For all models of the Boeing 737, the flight cycle implementation time is 60,000 flights.

(g) For all models of the Boeing 747, the flight cycle implementation time is 15,000 flights.

(h) For all models of the Douglas DC-8, the flight cycle implementation time is 30,000 flights.

(i) For all models of the Douglas DC-9/MD-80, the flight cycle implementation time is 60,000 flights.

(j) For all models of the Douglas DC-10, the flight cycle implementation time is 30,000 flights.

(k) For all models of the Lockheed L-1011, the flight cycle implementation time is 27,000 flights.

(l) For the Fokker F-28 Mark 1000, 1000C, 2000, 3000, 3000C, and 4000, the flight cycle implementation time is 60,000 flights.

PART 129 - OPERATIONS: FOREIGN AIR CARRIERS AND FOREIGN OPERATORS OF U.S.-REGISTERED AIRCRAFT ENGAGED IN COMMON CARRIAGE

1. The authority citation for part 129 continues to read as follows:

Authority: 49 U.S.C. 1346, 1354(a), 1356, 1357, 1421, 1502, 1511, and 1522; 49 U.S.C 106(g)

2. A new § 129.XXX is added to read as follows:

* * * * *

§ 129.XXX Repair assessment for pressurized fuselages

No certificate holder may operate an Airbus Model A300, British Aerospace Model BAC 1-11, Boeing Model 707, 720, 727, 737 or 747, McDonnell Douglas Model DC-8, DC-9/MD-80 or DC-10, Fokker Model F28, or Lockheed Model L-1011 beyond the applicable flight cycle implementation time specified below, or [a date one year after the effective date of the amendment], whichever occurs later, unless its operation specifications have been revised to reference repair assessment guidelines applicable to the fuselage pressure boundary (fuselage fuselage skins and bulkhead webs), and those guidelines are incorporated in its maintenance program. The repair assessment guidelines must be approved by the FAA Aircraft Certification Office (ACO) having cognizance over the type certificate for the affected airplane.

(a) For the A300, the flight cycle implementation time is:

(1) Model B2, 36,000 flights.

(2) Model B4-100, 30,000 flights above the window line, and 36,000 flights below the window line.

(3) Model B4-200, 25,500 flights above the window line, and 34,000 flights below the window line.

(b) For all models of the BAC 1-11, the flight cycle implementation time is 60,000 flights.

(c) For all models of the Boeing 707, the flight cycle implementation time is 15,000 flights.

(d) For all models of the Boeing 720, the flight cycle implementation time is 23,000 flights.

(e) For all models of the Boeing 727, the flight cycle implementation time is 45,000 flights.

(f) For all models of the Boeing 737, the flight cycle implementation time is 60,000 flights.

(g) For all models of the Boeing 747, the flight cycle implementation time is 15,000 flights.

(h) For all models of the Douglas DC-8, the flight cycle implementation time is 30,000 flights.

(i) For all models of the Douglas DC-9/MD-80, the flight cycle implementation time is 60,000 flights.

(j) For all models of the Douglas DC-10, the flight cycle implementation time is 30,000 flights.

(k) For all models of the Lockheed L-1011, the flight cycle implementation time is 27,000 flights.

(l) For the Fokker F-28 Mark 1000, 1000C, 2000, 3000, 3000C, and 4000, the flight cycle implementation time is 60,000 flights.

Issued in Washington, D.C. on

8.0 Proposed Advisory Circular

8.1 Introduction

The following AC has been reviewed by the FAA. This review included legal, technical content and economic considerations. The technical content has been reviewed by both Aircraft Certification and Flight Standards offices. Comments from all FAA reviews have been incorporated into the text of the AC.

8.2 Advisory Circular Viewpoint

The viewpoint of this AC is from the aspect that all necessary OEM documentation needed to accomplish the rule has been approved and issued. This viewpoint will exist at the time of rule codification but does not exist at the writing of this report. The goal is to complete the necessary SRM updates and model specific documents within one year of AAWG, ARAC and STG adoption of the recommendations contained here in but not later than one year prior to the effective date of the rule.

8.3 Proposed Advisory Circular Text

Advisory Circular

Subject:	Repair Assessment of Pressurized Fuselages	**Date:** 12/12/96 **Initiated by:**	**AC No:** 121-XX **Change:**

1. PURPOSE. This advisory circular (AC) provides guidance to operators of A300, BAC 1-11. B707/720, B727, B737, B747, DC-8, DC-9/MD-80, DC-10, F28, or L-1011 airplanes operated under 14 CFR parts 91, 121, 125 and 129 of the Federal Aviation Regulations (FAR) on how to incorporate FAA-approved repair assessment guidelines into their FAA-approved maintenance or inspection program. Like all advisory circular material, this AC is not, in itself, mandatory, and does not constitute a regulation. Terms used in this AC such as "shall" and "must" are used only in the sense of ensuring applicability of this particular method of compliance when the acceptable method of compliance described herein is used. While these guidelines are not mandatory, they are derived from FAA and industry experience in determining compliance with the pertinent FAR. This advisory circular does not change, create any additional, authorize changes in, or permit deviations from regulatory requirements.

2. RELATED FAR MATERIAL. The following regulations provide additional information concerning the subjects discussed herein:

a. Sections 25.571 and 25.1529 of 14 CFR part 25.

b. 14 CFR parts 43, 91, 121, 125, and 129.

3. RELATED GUIDANCE MATERIAL. The following documents provide additional information concerning the subjects discussed in this AC.

a. Advisory Circular 25.571-1 B(?), dated XX/XX/XX, Damage Tolerance and Fatigue Evaluation of Structure.

b. Advisory Circular 25.1529-1, dated 8/1/91, Instructions for Continued Airworthiness of Structural Repairs on Transport Airplanes.

c. A Report of the Aviation Rulemaking Advisory Committee's Airworthiness Assurance Working Group entitled, "Continued Airworthiness of Structural Repairs."

(A copy of this report may be obtained from the FAA Office of the Chief Counsel, Attn: Rules Docket (AGC-200), Docket No. XXXXX, 800 Independence Avenue SW., Washington, D.C. 20591.

4. DISCUSSION.

a. Title 14 CFR Parts 91, 121, 125, and 129 include requirements for a structural integrity assessment of fuselage pressure boundary (fuselage fuselage skins and bulkhead webs) repairs on certain model A300, BAC 1-11, B707/720, B727, B737, B747, DC-8, DC-9/MD-80, DC-10, F28, and L-1011 transport category airplanes. These rules require the incorporation of FAA-approved repair assessment guidelines for the fuselage pressure boundary into the FAA-approved maintenance or inspection program of each operator of these airplane models.

b. The manufacturers have developed model specific repair assessment guidelines to evaluate the damage tolerance of the types of repairs expected to be found. This AC provides guidance on how those model specific repair assessment guidelines may be incorporated into an operator's maintenance or inspection program. Model specific repair assessment guidelines for the affected airplanes may be obtained from the manufacturer.

5. BACKGROUND.

a. In June 1988, the FAA sponsored a conference on aging airplanes. As a result of that conference, the Airworthiness Assurance Task Force (AATF), representing the interests of the aircraft operators and manufacturers, regulatory authorities, and other aviation representatives, was established in August 1988. The task force set forth five major elements of a program for keeping the aging fleet safe. For each airplane model in the aging transport fleet: (1) select service bulletins describing modifications and inspections necessary to maintain structural integrity; (2) develop inspection and prevention programs to address corrosion; (3) develop generic structural maintenance program guidelines for aging airplanes; (4) review and update the Supplemental Structural Inspection Documents (SSID) which describe inspection programs to detect fatigue cracking; and (5) assess damage-tolerance of structural repairs.

b. The requirements to incorporate repair assessment guidelines into the maintenance or inspection programs for certain large transport airplanes address the fifth element.

6. REPAIR ASSESSMENT PROCESS. Utilizing the repair assessment guidelines developed by the manufacturer, there are two principle techniques that can be used to accomplish the repair assessment. The first technique involves a three-stage procedure.

This technique could be well suited for operators of small fleets. The second technique involves the incorporation of the repair assessment guidelines as part of an operator's routine maintenance program. This approach could be well suited for operators of large fleets and would evaluate repairs at predetermined planned maintenance visits as part of the maintenance program. Manufacturers and operators may develop other techniques, which would be acceptable as long as they fulfill the objectives of the rules and are FAA approved.

a. The first technique generally involves the execution of the following three stages:

(1) Stage 1: Data Collection.

(a) Older airplanes may have a great number of structural repairs. Since the records on most of these repairs are not readily available, locating the repairs necessitates a survey of the structure of each airplane. This stage specifies what structure should be assessed for repairs and collects data for further analysis. If a repair is on a structure in an area of concern, the analysis continues; otherwise, the repair does not require classification per this program.

(b) The repair assessment guidelines for each model will provide a list of structure for which repair assessments are required. Some manufacturers have reduced this list by determining the inspection requirements for critical details. If the requirements are equal to normal maintenance checks, such as the Baseline Zonal Inspection (BZI) (typical maintenance inspection intervals assumed by the manufacturers to be performed by most operators) those details were excluded from this list.

(c) The manufacturers have developed a survey form that may be used to record key repair design features needed to accomplish a repair assessment. Airline personnel not trained as damage tolerance specialists can use the form to document the configuration of each observed repair.

(d) Repair details are collected for further analysis in Stage 2. Repairs found during data collection that do not meet the static strength requirements or are in a bad condition are immediately identified and corrective action must be taken before further flight.

(2) Stage 2: Repair Classification. Using the information from a survey form, it is possible to classify repairs into one of 3 categories:

(a) Category A: A permanent repair for which the BZI is adequate to ensure continued airworthiness (inspectability) equal to the unrepaired surrounding structure. The operator's approved maintenance or inspection program must be at least as rigorous as the BZI.

(b) Category B: A permanent repair that requires supplemental inspections to ensure continued airworthiness.

(c) Category C: A temporary repair that will need to be reworked or replaced prior to an established time limit. Supplemental inspections may be necessary to ensure continued airworthiness prior to this limit.

(3) Stage 3: Determination of Structural Maintenance Requirements.

(a) The supplemental inspection and/or replacement requirements for Category 'B' and 'C' repairs are determined in this stage. Inspection requirements for the repair are determined by calculation or by using predetermined values provided by the manufacturer, or other values obtained using an FAA-approved method.

(b) In evaluating the first supplemental inspection, Stage 3 will define the inspection threshold in flight cycles measured from the time of repair installation. If the time of installation of the repair is unknown and the airplane has exceeded the assessment implementation times or has exceeded the time for first inspection, the first inspection should occur by the next "C check" interval or equivalent cycle limit after the repair data is gathered (Stage 1).

(c) An operator may choose to accomplish all three stages at once, or just Stage 1. In the latter case, the operator would be required to adhere to the schedule specified in the FAA-approved model specific repair assessment guidelines for completion of Stages 2 and 3.

(d) Incorporating the maintenance requirements for Category 'B' and Category 'C' repairs into an operator's individual airplane maintenance or inspection program completes the repair assessment process for the first technique.

b. The second technique would involve setting up a repair maintenance program to evaluate all fuselage pressure boundary repairs at each predetermined maintenance visit to confirm that they are permanent. This technique would require the operator to choose an inspection method and interval in accordance with the FAA-approved repair assessment guidelines. The repairs whose inspection requirements are fulfilled by the chosen inspection method and interval would be inspected in accordance with the regular FAA-approved maintenance program. Any repair that is not permanent, or whose inspection requirements are not fulfilled by the chosen inspection method and interval, would either be: (1) upgraded to allow utilization of the chosen inspection method and interval, or (2) individually tracked to account for the repair's unique inspection method and interval requirements. This process is then repeated at each inspection interval.

Repairs added between the predetermined maintenance visits, including interim repairs installed at remote locations, would be required either to have a threshold greater than the length of the predetermined maintenance visit or to be tracked individually to account for the repair's unique inspection method and interval requirements. This would ensure the airworthiness of the structure until the next predetermined maintenance visit, at which time the repair would be evaluated as part of the repair maintenance program.

Whichever technique is used, there may be some repairs that cannot easily be upgraded to Category 'A' for cost, downtime, or technical reasons. Such repairs will require supplemental inspections, and each operator should make provisions for this when incorporating the repair assessment guidelines into its maintenance program.

NOTE: The repair assessment guidelines provided by the manufacturer do not generally apply to repairs to structure modified by a Supplemental Type Certificate (STC). The operator, however, is still responsible for evaluating the entire fuselage pressure boundary in accordance with the program objectives. This means that the operator should develop, submit and gain FAA approval of guidelines to evaluate repairs to such structure. (See paragraph 8 of this AC).

7. IMPLEMENTATION. The means by which the repair assessment guidelines are incorporated into a certificate holders FAA-approved maintenance or inspection program is subject to approval by the certificate holders principal maintenance inspector (PMI) or other cognizant airworthiness inspector. When the PMI/cognizant airworthiness inspector having oversight responsibilities for the operator is satisfied that the operators continued airworthiness maintenance or inspection program contains all the elements of the FAA-approved manufacturer's repair assessment guidelines, the PMI/cognizant airworthiness inspector can approve an operation specification(s) or inspection program revision. However, the following guidance should be considered when implementing the program.

a. If the proposed maintenance or inspection program revises any of the FAA-approved repair assessment guidelines, the proposal must be submitted to the FAA Aircraft Certification Office (ACO) having cognizance over the type certificate for the affected airplane.

b. Existing Repairs.

(1) The repair assessment process should be completed in accordance with the schedule in the FAA-approved model specific repair assessment guidelines for each of the affected airplanes. Any necessary actions (revised inspection programs, etc.) to be taken as a result of the assessment would be incorporated into the FAA-approved maintenance or inspection program.

(2) Structural repairs mandated by Airworthiness Directive (AD) do not always contain instructions for future supplemental inspection requirements. If the repair assessment establishes a supplemental inspection requirement where one does not exist in the AD, the operator is not required to obtain an Alternative Means of Compliance (AMOC) to conduct those inspections. The operator would, however, be required to obtain an AMOC if the repair is modified.

c. New Repairs. Unless new repairs are accomplished according to structural repair manuals, or other equivalent method that incorporates damage tolerance methods of design and evaluation, the operator should establish a means within the maintenance or inspection program to assess new repairs using FAA-approved repair assessment guidelines. A two-stage structural evaluation and FAA approval process, described in Advisory Circular 25.1529-1, is an acceptable means of assessing the damage tolerance requirements of new repairs.

d. Reporting Requirements. There are no special reporting requirements associated with the incorporation of the repair assessment guidelines in the operator's maintenance or inspection program. The operators are, however, encouraged to report significant findings to the manufacturers in order to ensure that, if necessary, prompt fleet action be taken. Normal reporting required under 14 CFR § 121.703 would still apply.

e. Recordkeeping Requirements. Incorporation of the repair assessment guidelines does not impose any new FAA recordkeeping requirements. However, as with all maintenance, the current operating regulations (e.g., 14 CFR § 121.380) already impose recordkeeping requirements that would apply to the actions required by the rules. When incorporating the repair assessment guidelines into its approved maintenance program, each operator should address the means by which it will comply with these already established requirements. The means of compliance, along with the remainder of the program, is subject to approval by the PMI or other cognizant airworthiness inspector.

f. Implementation Time. The implementation time for assessments of existing repairs is based on the findings of repair assessment surveys and fatigue damage considerations. The implementation times for incorporation of the repair assessment guidelines into an airplane's maintenance or inspection program are specified in §§ 91.XXXX, 121.XXXX, 125.XXXX, and 129.XXXX of the FAR.

g. Beginning of Assessment Process. After the guidelines are incorporated into the maintenance or inspection program, operators must begin the assessment process for existing fuselage repairs within the flight cycle limit specified in the FAA-approved model specific repair assessment guidelines. There are three deadlines for beginning the repair assessment process, depending on the cycle age of the airplane on [the effective date of the rule].

(1) Airplane Cycle Age Equal to or Less Than Implementation Time on the Rule Effective Date. The operator must incorporate the repair assessment guidelines in its maintenance or inspection program by the flight cycle implementation time, or one year after the effective date of the rule, whichever occurs later. The assessment process would begin (e.g., accomplishment of Stage 1) on or before the cycle limit specified in the repair assessment guidelines (generally equivalent to a "D check") after the incorporation of the guidelines.

(2) Airplane Cycle Age Greater Than the Implementation Time but Less Than the Design Service Goal on the Rule Effective Date. The operator must incorporate the repair assessment guidelines in its maintenance or inspection program within one year of the rule effective date. The assessment process would begin (e.g. accomplishment of Stage 1) on or before the cycle limit specified in the repair assessment guidelines (generally equivalent to a "D check"), not to exceed the cycle limit computed by adding the DSG to the cycle limit equivalent of a "C check" interval (specified in the repair assessment guidelines), after incorporation of the guidelines.

(3) Airplane Cycle Age Greater Than the Design Service Goal on the Rule Effective Date. The operator must incorporate the repair assessment guidelines in its maintenance or inspection program within one year of the rule effective date. The assessment process would begin (e.g. accomplishment of Stage 1) on or before the next cycle limit specified in the repair assessment guidelines (equivalent to a "C check") after incorporation of the guidelines.

h. Maintenance Program Changes. When a maintenance or inspection program interval is revised, the operator must evaluate the impact of the change on the repair assessment program. If the interval escalation reduces the frequency of inspection of the affected area below the BZI, the previous classification of Category A repairs may become invalid. The operator may need to obtain approval of an alternative inspection method, upgrade the repair to allow utilization of the chosen inspection method and interval, or recategorize some repairs and establish unique supplemental inspection methods and intervals for specific repairs. Operators using the "second technique" of conducting repetitive repair assessments at predetermined maintenance visits would evaluate whether the change to the predetermined maintenance visit continues to fulfill the repair inspection requirements in accordance with the guidance provided in paragraph 6b of this AC.

i. Sale and Transfer of Airplanes. Before an airplane is added to an operator's operations specifications, a program for accomplishment of the repair assessment should be established in accordance with the following:

(1) For airplanes that have previously been operated under an FAA-approved maintenance program, the new operator should begin the repair assessment process in accordance with the previous operator's schedule, or with the new operators schedule, whichever would result in an earlier accomplishment date for the assessment.

(2) For airplanes that have not previously been operated under an FAA-approved maintenance program, the operator should begin the repair assessment in accordance with the deadlines specified in paragraph 7g of this AC. If the airplane design service goal and compliance times have been exceeded, the repair assessment should be accomplished prior to the airplane being added to the air carrier's operations specifications, or in accordance with a schedule approved by the PMI or other cognizant airworthiness inspector.

j. Operation of Leased Foreign Owned Airplanes. Acquisition of a leased foreign-owned airplane for use in Part 91, 121, 125, or 129 operation will require that the certificate holder determine the status of the airplane relative to the model specific implementation times. If the airplane has exceeded or is within one year of exceeding the implementation time, the certificate holder should implement the repair assessment program in the airplane's maintenance program before revenue operation. Implementation of the assessment programs then would occur per the model specific manufacturers repair assessment guidelines. Airplanes well below the implementation time would implement the assessment program by the time the airplane reached the model specific implementation time.

8. REPAIRS TO STRUCTURAL MODIFICATIONS CERTIFIED BY A SUPPLEMENTAL TYPE CERTIFICATE (STC).

a. The operator will need to establish a program for repair of structure modified by an STC. Those repairs that can be evaluated using the manufacturer's model specific repair assessment guidelines should be documented and submitted to the operator's PMI/cognizant airworthiness inspector for approval. The PMI/cognizant airworthiness inspector may approve the program subject to the guidance in paragraph 7 of this AC. For all other repairs, a separate program will need to be developed.

b. It is recognized that the operators do not usually have the resources to determine a DSG or to develop repair assessment guidelines for structure approved under STCs. The operator may need to seek help in showing compliance, and this help would normally be provided by the STC holder. In the event that the STC holder is unable to provide this assistance and the repair is of a size or type that excludes it from being treated like a repair in the manufacturer's SRM, model specific documents, or other approved source, the operator may have to hire the necessary expertise to develop and gain approval of repair assessment guidelines and the associated DSG.

c. The cost and difficulty of developing guidelines for modified structure may be less than that for the basic airplane structure for three reasons. First, the only modifications made by persons other than the manufacturer that are of concern are those that affect the fuselage pressure boundary. Of those that do affect this structure, many are small enough to qualify as Category "A" repairs under the repair assessment guidelines, based solely on their size. Second, if the modified structure is identical, or very similar, to the manufacturers original structure, then repairs made to the structure modified by an STC are probably covered by referencing the manufacturer's guidelines and the SRM. Third, the modification may have been made so recently that no repair assessment guidelines would be needed for many years. Compliance with the rules could be shown by establishing the DSG for the new modified structure, calculating an implementation time that is equal to three quarters of that DSG, and then adding a statement to the operations specifications that repair assessment guidelines would be incorporated into the maintenance program by that time. No guidelines would be needed until 75 percent of the new DSG is reached.

9. <u>ALTERNATE METHODS</u>. As specified previously, this AC provides a means of compliance with the rules. If an operator wishes to develop its own repair assessment guidelines and submit such guidelines for FAA approval, it may do so. The proposed repair assessment guidelines must ascertain the "damage-tolerance" of the repairs to the extent necessary to establish what supplemental maintenance actions, if any, are necessary to assure that fatigue damage will be detected before the damage degrades the load carrying capability of the structure below certification levels. The proposed guidelines should be submitted jointly to the operator's PMI/cognizant airworthiness inspector and the FAA Aircraft Certification Office (ACO) having cognizance over the type certificate for the affected airplane.

9.0 Conclusions

Continued airworthiness of existing repairs on aging airplanes was one of the five initiatives chartered by AATF/AAWG in 1988. Considerable activities occurred during 1989-1994 to develop consistent and comprehensive OEM guidelines for operator assessments of repairs.

AAWG conducted surveys of 65 airplanes. The surveys covered repairs on nine different aging airplane models. No immediate airworthiness concerns were observed. Some repairs of good quality may inhibit damage detection during normal maintenance activities and therefore may need supplemental inspections due to size, configuration and/or proximity consideration. It was also concluded that the operators need repair assessment procedures from the OEMs for existing and new repairs on aging airplanes.

The following are the conclusions from this report:

- The industry as a whole lacks sufficient information and training to evaluate previous installed repairs for continued airworthiness.
- Some existing repairs may require supplemental inspections to maintain structural airworthiness.
- Sufficient operational rules exist to enforce inspection programs on repairs for structural integrity but may not be sufficient to highlight the concern and necessary action to be taken.
- Data from surveys of repairs indicates no immediate airworthiness concern for previously installed repairs.
- Fuselage pressure boundary repairs represent the most significant concern to safety.
- Airline maintenance programs are focused to identify questionable repairs and replace them.

10.0 Recommendations

Based on the conclusions of this report and with respect to the fuselage pressure boundary [skin and bulkheads] it is recommended:

- That the Federal Aviation Administration (FAA) consider a rule change to 14 CFR 91, 121, 125, and 129 be promulgated to ensure that an assessment for continued airworthiness for structural repairs on the fuselage pressure boundary of the Airbus A - 300 BAC 1 - 11; Boeing 707/720, 727, 737, 747; Douglas DC - 8, DC - 9/MD - 80, DC - 10; Fokker F-28; and the Lockheed L - 1011 be accomplished. The suggested wording of these new rules is contained in Section 7 of this report.
- That the FAA consider an Advisory Circular to provide guidance on rule accomplishment. The suggested wording of this Advisory Circular is contained in Section 8 of this report.
- That the Original Equipment Manufacturer (OEM) provide sufficient published data in the SRM, supported by model specific repair assessment guidelines material, to enable the operator to assess existing and proposed repairs.
- That the FAA require Supplemental Type Certificate Applicants to evaluate the effect of repairs in the vicinity of the planned structural modification for potential impact to continued airworthiness.
- That the Transport Aircraft and Engine Issue Group (TAEIG) recommend that the issues discussed in this report become the subject of an international harmonization task.
- That the OEMs provide repair assessment briefings and training to operator maintenance and engineering personnel and regulatory agencies within one year of initial publication of model specific repair assessment procedures.